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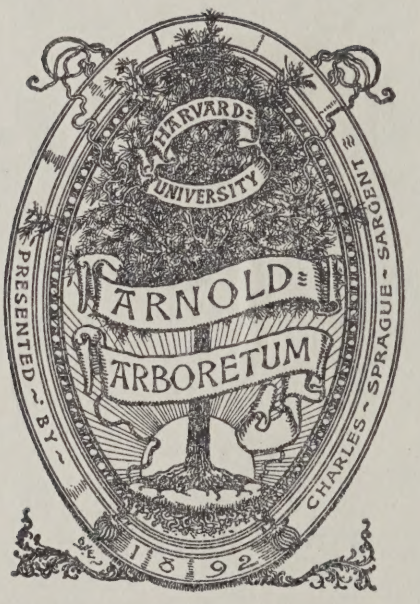

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VOLUME 3

OCTOBER 1925 TO APRIL 1926

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CANTON CHRISTIAN COLLEGE
CANTON, CHINA

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Published by the Ling Nan Agricultural College

Canton Christian College

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* In the absence of Mr. G. W. Groff much of the present issue has been edited by William E. Hoffmann who henceforth will assume editorship of the Review.

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THE FLOOD PROBLEM OF KWANGTUNG

by

G. W. Olivecrona

Engineer-in-Chief,

Board of Conservancy Works of Kwangtung

In the following paper I wish to put before the public the Flood Problem of Kwangtung, such as it appears to the hydraulic engineer, but in such a way that the layman will also be able to grasp the purport of the problem, and to form, for himself, an idea of its magnitude. Here I will give, in a concise form, a brief statement of the condition of the rivers. This statement is based upon scientific investigations of the causes that rule the flow. I will also outline the methods that must be applied in order to control the floods.

On a stretch of coast, 60 miles in length, no less than four rivers debouch into the sea, viz, the West, the North, the Pearl, and the East Rivers, discharging during the rainy season about 2,000,000 cu. ft. of water per second.

I will begin by giving you a general brief description of the geographical and the hydrographical features of these four rivers. The Han or Swatow river, draining the extreme north-eastern part of the Kwangtung province, will not be dealt with in this context, as it forms a river system of its own, entirely separated from the four rivers under discussion.

The West River

The West River or Sikiang, with its tributaries, drains, broadly speaking, the whole province of Kwangsi, the eastern part of Yunnan, the southern part of Kweichow, but only a small part of Kwangtung, or about 1/10 of the whole province. Its drainage basin covers an area, within which could be placed the whole of Great Britain and Ireland, together with the Kingdom of Denmark.

The river is navigable, even during the dry season, as far as Wuchow, for craft having a draft not more than 6 ft.; but beyond this place only for native boats and flat-bottomed motor-boats, as several rapids form obstructions difficult to overcome. Small boats may proceed with certainty up to Hingi in Kweichow, a distance of about 530 miles from Wuchow.

A river of this magnitude naturally receives a great number of tributaries, but I will restrict myself to mention only the two largest of them, the Yuh Kiang and the Kwei Kiang. The latter, which also is called Fu Ho, has in its upper course a canal built in 214 B.C. This canal is connected with the river Siang Kiang, belonging to the Yangtze River system. Siang Kiang debouches into the Tung Ting Lake.

In old days this canal was the connecting link between the Kwangtung and the Yangtze River systems, and made it possible to ship tribute rice and merchandise, inland, from Canton to Peking.

At flood time the rivers rise tremendously. During the big floods of 1915 the water at Wuchow rose 82.3 ft. above the lowest water level on record. That is to say, if we should mark this height on the Sun Company's Building on the Bund, the water would reach to the fifth floor. The average rise is about 61 ft. above the lowest low-water mark, and such floods are generally not dangerous to the dykes along the river. Still, even moderate floods may cause inundation, not by over-topping the dykes, but by washing out those dykes which are not of a sufficiently strong construction. During the year 1915, the quantity of water passing Wuchow at the highest stage was 2,100,000,000 cu. ft. per second. That means, that if this quantity had been confined within the old city walls of Canton, the water would have risen, in one hour, to a height of 157 ft. above the ground, and would have entirely covered the Sincere Building. I will give another example. If the river had, at that time, been led into the Shuntak district, and that district had been surrounded by a wall, 13 ft. in height, this basin would have been filled up to the top of the wall in 24 hours. The highest rise in 24 hours at Wuchow was 22 ft. during the summer flood of 1924.

The North River

The North River, or Pei Kiang, is next in size to the West River, but comparatively a small one, having a drainage area of only 1/7 of that for the West River. The North River also has a great number of tributaries. The most important of them are the Wushui, the Yungkiang, the Linchowkiang, and the Sui Kong or Bamboo River. This river rises in the northern part of the province, having its sources on the southern slopes of the Meiling range, which latter separates the Kwangtung and Kwangsi provinces.

The North River is in communication with the Canton River through the Lupao Channel, the Sainam Channel, the Fatshan Channel, and, south of the latter, through several channels above and below Chanchuen. It is only during the flood season that water flows from the Lupao and Sainam channels to the Canton River. Sandbanks formed in their openings cut off water communications during the dry season. In the other channels the water flows both ways, according to the ebb and flood in the sea.

The North and the West Rivers are in permanent communication through the Junction Channel at Samshui. Any variation of flow in the one river, therefore, exercises a certain influence upon the flow in the other. During the wet season the West River is the dominating one, and the water flows from that river into the other; but in the dry season the reverse frequently occurs so that the water in the North River goes into the West River.

The Pearl River

The Pearl River, or Chu Kiang, is only a small river, compared with other rivers of Kwangtung province. It may even be open to question whether the Pearl River, should be considered as an independent river at all, or only as a branch of the North River. Furthermore, it has more the character of a tidal channel than that of a river proper. A study of the map gives the impression, that the river is principally fed from the North River, and also, via the Samshui junction, from the West River. This is, indeed, the fact during the wet season. In the dry season the Canton River drains the country situated between the basins of the North and East Rivers, and has the character of an independent river.

The East River

The East River, or Tung Kiang, forms a water system of its own, entirely separated from, and independent of, the other systems. It drains the land to the East of the Canton-Kowloon railway and comes from the mountains on the boundaries of Kwangtung, Kiangsi, and Fukien.

All these four rivers have together built up the Canton Delta, a vast plain of alluvial soil which covers an area of about 3,100 sq. miles, situated to the South of Canton and to the West of Sheklung. This area has a population of 8,000,000 to 10,000,000 people.

The Delta

The Delta is penetrated by an immense number of channels, formed partly by nature, and partly by man, and in places dotted with isolated mountains. In ancient times, these mountains evidently formed parts of the archipelago, which surrounded the continent. In prehistoric times the seashore seems to have reached as far as the Ling Yang Gorge, forming a large bay where now the Kwangli enclosure lies, and extending to the White Cloud Mountains north of Canton. In this bay the West and North Rivers meandered between the islands out to the open sea, depositing their silt, and successively building up the plains now known as the Canton Delta. Simultaneously the East River approached from the East, building up land in the same way.

Every alluvial river is bound to extend its delta further out into the sea, as long as the littoral currents do not prevent its extension, by carrying the silt laden river-waters out to the deep sea. The West and North Rivers debouch through several channels into the sea, where the silt settles along the coast. Year after year the settling continues, resulting in an extension of the river-bottom outwards. As the river-bed is thus extended, the slope of the river becomes more gentle, causing a slacking of the current, and silting of the bed further up the river. A rise in water level is then bound to follow, giving again to the flow a velocity sufficient to carry the silt out to the sea, and thus equilibrium is restored.

If a river is confined within dykes, as is the case with the Kwangtung Rivers, no rise of the land surface by silting is to be counted on, as long as the dykes are intact. Following the growth of the river, towards the sea, the gradient must be maintained, and a rise of the bottom follows. The most effective means to stop the growing divergence in level, between the river bottom and the land, would be to give free access to the water to spread out over the land, there to unload its silt, and raise the river banks. To keep the bottom low by permanent dredging only is a very expensive operation, which can scarcely be resorted to in rivers of such magnitude as those of Kwangtung. As an example it may be stated, that deepening the river bed only 3 ft. on half its width, between Samshui and Tzetung, would cost at least 3.5 million dollars, whereas raising the dykes on both sides 3 ft., and giving them sufficient strength, would cost only about 400,000 dollars.

During a period, covering probably at least 800 years, the population in the south of Kwangtung has protected their low lying land against inundation by means of extensive embankments, running along the bank of the rivers, and their tributaries, also following the innumerable creeks, which are in communication with the main rivers.

At the time of their construction, the dykes were undoubtedly raised to a sufficient elevation, to prevent over-flow from the then prevailing high water. But in time the flood level has become higher, necessitating an increase of the height of the dykes. Where this has been done, successive additions of earth to top have been laid, without regard to the necessity of proportionately increasing the width of the base. The consequence of this inadvertence is too steep gradients, and insufficient width of the base of the dyke-section. The earth required for the work has often been procured from the lower part of the dyke itself, or dug out from the natural ground in the immediate vicinity of the base, thus weakening either the embankment itself or the foundation upon which it rests. For years this procedure has been carried on, and considerable quantities of earth have been removed from the lower part of the dyke to its top. The result is that the top width, as a general rule, has now become unnecessarily large as compared with that of the base.

Where the material for repairs has been taken from the ground near the dyke on the landside, more or less deep excavations now remain, being of considerable width and running parallel to the dyke. It is evident that if a part of the soil on the landside, close to the base, is taken away, the load which has to counterbalance the water pressure on the riverside is decreased. In this case the resistance of the foundation is weakened, and the danger of undermining arises. This phenomenon has been of common occurrence during recent floods.

The erection of houses on the tops and slopes of dykes is a common practice among the people and should be condemned. The excavation or driving of piles for foundations weakens the dykes, and the presence of the buildings interferes with proper inspection and repairs. The probable reason for building on the dykes is the desire to be near the river as a water supply. But it would pay in the end to move the houses further inland to higher ground, and construct an artificial water supply, rather than to run the risk of having them spoiled by floods year after year.

Another circumstance which causes serious damage to the dyke is the custom of laying the slopes under cultivation. As the durability of an earth-embankment depends on the protection given to its slopes, this durability is imperiled as soon as the cover is injured or taken away. The yearly ploughing of the slopes spoils the cover and exposes the soil to the erosion of the heavy summer rains.

But not content with the use of the dyke-slopes for agricultural purposes, the country people do not hesitate to carry on excavations in the dyke body itself in order to gain a few additional square feet of land for their adjacent rice-fields.

In other words, the dykes seem to be considered as "no man's land", which every one has the right to use for his own selfish purposes, instead of being looked upon as the common property of the whole population, for the safety of whose life they are provided.

It is not sufficient to construct a dyke, however strong, if the future upkeep is neglected and damage left without immediate attention. A cut out of the slope, which at the beginning may be of inconsiderable dimension, increases in the course of time, until the strength of the construction is so diminished that, when the floods occur, a catastrophe is certain to happen. The strength of a dyke system is determined by its weakest and lowest section, and it is useles to give to one part of it a strength which is not shared by the rest.

There are, it is true, committees for every dyke district, formed by delegates from the different communities within the protected area, whose function it is to supervise and carry out necessary repairs. In most cases these committees have no aptitude for dealing in a thorough way with the problems which arise, and their oversight is limited to only their part of the dyke-system. The dyke is like a chain; if one link breaks the chain fails to do its duty. Consequently, a district surrounded by a continuous embankment, on whose solidity and maintenance the safety of the whole enclosed area depends, is often kept under supervision by several committees, each working in its own interests, without any cooperation whatever. The result is, that one part of the embankment may be well kept up, while another is left to its fate, one committee being well supplied and the other ill supplied with funds.

It seems, therefore that one homogeneous organization, with sufficient power, independent of local influence, and possessing the requisite qualifications to overcome technical obstacles, is the only suitable corporation to conduct the dyke supervision.

I have now given you a general conception of the condition of the rivers, and of the means which have hitherto been applied in trying to confine the floods to the river-bed. We will now investigate if there are any other ways to prevent the flooding of the low lying country. The principal means suggested as remedies against the violating floods may be classified as follows:—

1. Afforestation of the drainage basin.
2. Creating new outlets to the sea.
3. Storing the floods in reservoirs.
4. Cutting off bends and dredging of the river-bed.

I will examine the effectiveness of each of these means in their proper turn, and also state their influence upon the floods, if applied on the Kwangtung Rivers.

Afforestation of the Drainage Basin

There exists in the public mind an impression that the prime cause of the floods has been the destruction of forests in the river valleys, and that the surest way to prevent them is by reforestation. This conception is held not only by laymen, but also has been advocated by hydraulic engineers, though more as a matter of theory than founded on actual observations. Recent investigations, based on facts collected during a long sequence of years, have so far, in a measure, changed this conception amongst the experts on hydraulics. Still there is a great diversity of opinion on the subject, some maintaining that the cutting down of forests will ultimately convert a country into a desert, while others claim that a moderate cutting down of the forest even increases the rainfall.

The fact remains that in Europe as well as in America remarkable series of great floods, in land covered with woods, have not occurred more frequently *after* the forests were cut down. It is also argued by some, that with reforestation, if the floods occasionally were high, they would not be as frequent. However, where long periods of records are available, they do not always verify this apprehension.

It is generally accepted by both sides that the leaves falling from forest trees, as they decay, form a humus which has a capacity to absorb water. However, after this capacity is utilized, a condition which soon will arrive in countries subject to heavy rainfalls at short intervals, the retarding influence of humus on the run-off is more or less lost. It will require tens of years to produce a good forest growth within the drainage basin of a river. After that half a century will probably be required for the leaves to decay in sufficient quantities to produce a layer of humus thick enough to absorb the rainfall.

Under the assumption that reforestation would reduce the flood discharge of a stream to one-half, I have made an estimation of the forested area that would be required to lower the flood heights in the

North River to an elevation of 1 foot below the present dyke crests at Tsingyun. I have found that at least 65 per cent of the total drainage basin, amounting to about 12,000 sq. miles, would have to be covered with forest to bring about such effect. Even with the best organization, and unlimited resources, it is doubtful if the government or the communities would be able to inaugurate such a scheme.

The following illustrates what happens when a heavy downpour drenches a wood land. If we take a piece of blotting paper and place it on a glass square, and give to that square an inclination, and then pour water over the blotting paper, the water will be absorbed by the paper and be prevented from flowing down the glass square for a certain period of time; but, when the paper has exhausted its capacity to absorb more water, the surplus water will begin to flow down the square as freely as if no blotting paper were there at all. This illustrates what happens in nature when heavy precipitations discharge over a mountainous country covered with vegetation.

From another point of view afforestation would play a part in the future regime of the river. Through lack of cover by vegetation, the mountains are now freely exposed to erosion, and, besides, their surfaces are brought to a state of decomposition. Heavy showers, which are frequent in these regions, carry quantities of decomposed matter down into the river valleys, and this accounts for the silt deposits met with in their lower courses. A scheme of afforestation on the mountain slopes in the vicinity of the rivers would keep the soil in place and would be justified for that purpose only. But a much more important circumstance to be considered is the general economical benefit for the whole country, derived from forest cultivation. This speaks in favour of the adoption of an afforestation scheme throughout the drainage basins, worked in a scientific way and supported by the authorities as well as by the country people themselves.

As the only, immediate, or principal remedy against floods, afforestation is not to be recommended.

Creating New Outlets to the Sea

A scheme which has been much ventilated among laymen is that of creating an additional outlet for the West River, either to the Tongking Gulf or the South China Sea. In the first case, an outlet for the main river should be sought for between Wuchow and Sunchow or, for the Yuh Kiang, between the latter place and Nanning. In the second case, an outlet to the sea from any suitable point between Wuchow and the Ling Yang Gorge would have to be constructed.

The West River valley, above Ling Yang Gorge as far as the junction of Yuh Kiang, is separated from the sea coast by huge mountain ranges, their main direction being from East to West, with a number of branches stretching to the North and to the South.

The Yuh Kiang valley is in a similar way isolated from the coast of Tongking Bay. The branch mountains sometimes form between them gently declining valleys, those sloping to the North being separated from those sloping to the South by an apparently low saddle, which, for the layman seem to be easy enough to overcome, but, when inspected by the engineer, form unsurmountable obstacles for the construction of canals.

A study of available maps, and the general geographical conditions of the country, together with information collected from different sources, led to the conclusion that an attempt to cut through the watershed to the south would prove impossible. Nevertheless, investigations have been undertaken with the principal object of eliminating this scheme once for all.

No less than six different passes in the mountain ranges south of the West River have been examined, between Nanning and the Ling Yang Gorge, in order to ascertain if any possibilities exist to cut a canal big enough to lead off sufficient water, in order to prevent overtopping of the present dyke systems. Not in one single instance did the topographical aspect warrant such a possibility, and I am positive in my opinion that the idea of creating a flood discharge from any point between these places to the open sea, through a canal, must be entirely and finally abandoned.

Storing The Flood In Reservoirs

The plan of controlling the floods by means of reservoirs, in which part of the water is held back during the flood season, again to be released at a lower stage in the river, appears to have met with much popular approval. To the hydraulic engineer, this way of controlling floods is no novelty; its advantages have been thoroughly studied and its limitations are also well known. The very function of reservoirs, that of filling, holding, and emptying their supply of water as required, abstractly renders them particularly adapted to serve to reduce the natural fluctuations in the volume of rivers. This influence is similar in kind to that of natural lakes, but is theoretically even more effective, because the release of the water of a reservoir is wholly under control, while that of lakes is relatively unrestrained. But there are two practical considerations which limit their employment; these are, the storage capacity required for efficiency, and the ever present question of cost. Only where the natural conditions are favourable can the reservoir system for preventing floods be adapted with advantage. As its value rapidly diminishes with distance, it must be close to the locality which is to be benefited.

Generally from a constructive point of view, the best sites for reservoirs are found in the upper courses of the river system, and consequently the run-off in that part of the drainage basin only is regulated by the reservoir. The rest of the basin, in most case the larger part of it, continues as before to feed the river, and the beneficial influence of the storage in the upper courses is only slight in the lower ones. Great floods do not arise from average conditions, but from exceptional variations, such as are caused by a series of heavy rains, rapidly succeeding each other. Each rainstorm produces in the river a flood, the volume of which may be absorbed by a reservoir or a system of them. Should a second storm sweep over the valley, a short time after the first, the reservoirs to be effective must be emptied, or their capacity doubled. To hold all the excess rainfall until low water, would require reservoirs of enormous capacity. Therefore, as soon as a reservoir is filled, and has for the time played its part as a reducer of floods, it should be emptied in order to utilize the same space for a second rainfall. While reducing the flood crest at a given locality, the reservoir necessarily prolongs the period during which the river remains at a high stage. This condition is not desirable from an agricultural point of view, as it prevents the drainage of the lowland in the lower region of the river. A high but short flood may be preferable.

In rivers carrying much sediment during floods, reservoirs always run the danger of being silted, and thus losing part of their storing capacity. This is naturally a slow process. but it has to be taken into consideration when the advantages and disadvantages of reservoir systems are compared.

The prospect for introducing reservoirs along the course of the Kwangtung Rivers, as a preventive against inundation of the plains, is not especially encouraging. No site for a reservoir can be found below the gorges, without encroaching upon the rights of the rural population, by putting large and valuable cultivated regions under water. Above the gorges the land is less valuable, but here the valley of the rivers and its tributaries are generally so narrow, and of such steep gradient, that the construction of reservoirs of sufficient capacity is scarcely possible. Let us, however, for argument's sake presume that this is possible for the North River, and that we wish to store so much water as to keep the water level 1 foot below the crest of the dykes in the Tsingyun region. This means at least a reduction in flood height of 5 feet below the high-water level of 1915, which is the highest observed. It would then be necessary to store at least 23,800 million cu. ft. of water to gain the desired reduction at Tsingyun. A reservoir of that capacity would, if filled say to a height of 16 feet, cover an area of 52 sq. miles or 236,000 mao. Storing this volume would not produce a lowering of the flood height at Lupao of more than about 2.3 feet, and still less further down.

Independent of the success or failure of introducing reservoirs, the dykes in the lower course of the river must still remain as a defense against inundation, since we must keep in mind the fact that only a slight lowering of the extreme flood height would be attained by storing.

Cutting off Bends and Dredging of The River Beds

A method suggested for reducing flood height is the straightening of the river by means of cut-offs. It is believed, that by cutting off one or several bends, the discharge of water will increase at such a rate, as to produce a lowering of the flood level in general. Theoretically, an acceleration of the flow will follow, since shortening of the river gives to it a steeper slope. This change of condition, however, will only result in a lower flood level immediately above, and in the upper end of the cutting, while, at the lower end, an increase in flood height will take place, because the water rushes through the improved section much faster than the lower part is able to carry it off. The fact is, that cut-offs have been repeatedly tried in rivers as a means of reducing floods, but generally with unsatisfactory result. They afford relief in one locality, but only at the expense of other localities. Cut-offs are justified in case a higher flood level does not cause any inconvenience to the surrounding lands at the lower end, and even then, only when the benefit derived balances the cost of the construction of the canal. For shipping purposes, on the contrary, the straightening of a river may be in many cases advantageous.

Dredging of the river bed has often been held forth as the only means that would lower the flood level. And so it would, if only the once dredged canal remained open. This is, however, not to be expected in a silt-carrying stream for the following reason. By dredging the bottom, the cross section of the bed is made larger than before, which causes a slackening of the current velocity. This being a fact, the current is not strong enough to keep the silt suspended. It settles, and the dredged canal is soon silted again. No improvement can be obtained unless dredging operations are carried on perpetually. Such work would, in order to exercise any effect on the flood heights, reach a magnitude and involve such tremendous yearly outlays, that for economical reasons the method is not justified. It is, furthermore, not sufficient to dredge away a shoal here and there, expecting that such local operations will lower the floods in general. The river bottom, along its whole length, must be lowered from the mouth as far up the river as to where improvement is desired. Now, there are other means to keep the current in a dredged canal at such a speed that the silt is prevented from settling, namely the restriction of the width of the river bed by the help of cribwork and correctly located dyke systems. It is a false supposition that the lowering of the river bottom, say one foot, must effect the same lowering of the water level. The height of the water surface in a river depends, in its lower course, upon the height of the water level at its mouth, which in case of the Kwangtung Rivers is the sea level; and no human being can change that.

Experiences all over the world show that the lowering of flood heights is not obtainable, within reasonable costs, by dredging the bottom, though for navigation purposes it is often resorted to in silt carrying rivers.

Summary

Summing up what has been said, it is obvious that: firstly, reforestation, as a means of lowering the present floods, is not to be relied upon, but would, even if it should have some influence on the flow, postpone the salvation of the country for an indefinite period of time; secondly, that creating new outlets to the sea is out of the question; thirdly, that reservoirs, even if possible to construct, would only give a very slight relief from floods, and would in time lose their storing capacity on account of silting; and fourthly, that cut-offs and dredging of the river bottom, though advisable in some instances, would not alone be effective in lowering the water to a level that would give permanent security against overflow of the present dykes.

The previous investigations show that an improvement of the general flood conditions, falling within limits of available resources, cannot be derived from efforts to reduce the high water level. The remaining means to be taken into consideration agree with the conception of previous generations that an effective system of dykes bordering the main river as well as the tributaries and channels, where adjoined by low-lying land, thus confining the floods within stable limits, would give the protection needed against inundation.

Proposals of the Board of Conservancy Works

I will now give you a short description of the principal feature of the work which has been proposed by the Board of Conservancy Works, in order to prevent the yearly recurring flooding of the river valleys and delta.

The present dyke systems along the main rivers should be strengthened by substantial earthfill, and protected on the river side against scouring. Their height should be increased to a level reaching at least 3 feet above the expected highest waterlevel. The highest waterlevel shall be determined with the assumption that the river carries its total maximum discharge between the embankments. Where no dykes exist, new ones should be constructed. Creeks and channels now breaking off the continuity in the dyke systems should be closed. the smaller ones by ordinary flood gates, permanently shut during flood time; the large ones by movable dams, which will permit the regulation of flow in these channels. By thus confining the floods to the main rivers, an immense length of dykes, which now border the innumerable branch channels, will be superfluous. It must be borne in mind that these dykes, penetrating far into the interior, must, as conditions are at present, be constructed to the same height and strength as the dykes along the main river. In cases where these dykes should be necessary to maintain, as for instance along a channel in which the flow is restricted by a movable dam, they do not need to have the same height as the main dykes, but could be of a much cheaper structure. In other words, they would become of only secondary importance, and would be needed only for local purposes.

Concentrating the flow in a few channels will naturally increase its velocity, but this would only be an advantage. The silting would decrease, and the river bottom be lowered by scouring.

Following the course of the West River, the first dyke system met with is above Shiuhing. The dykes on both shores are reconstructed on the whole length down to Motomun, and the necessary flood gates and regulation dams erected. In the Delta a number of channels should be permanently closed by embankments.

The same principle is applied to the North and East Rivers.

Regarding the Pearl River dykes, their upkeep will become a purely local affair, as the proposed regulation dams at Lupao, Sainam, and Shahow will make possible such reduction of the flow that no danger of flooding is expected.

It is evident that the closing up of several channels during flood time is objectionable if looked upon from the interests of the shipping; but this nuisance would only last for a short period every year. The salvation of the people from the frequent inundations must carry more weight than a few weeks' inconvenience in transportation. Secure to the people favourable conditions of life, and means will be found to satisfy other needs.

Finally, a few words regarding the cost that would be involved in the completion of the scheme.

The West River work would cost	H. K.	$19,500,000
,, North ,, ,, ,, ,,	,,	$10,900,000
,, East ,, ,, ,, ,,	,,	$ 4,600,000
	H. K.	$35,000,000

The total area that would be saved extends from Siusang Gorge in the West to Poklow in the East, and from Feloi Gorge in the North to Heungshan in the South.

The cost for eliminating the danger would amount to, in round figures, $4.60 per mow of cultivated land. Considering that one rice-crop represents a value of $25 to $30 per mow, a cost for necessary protection work of $4.60 is insignificant. I have estimated the time for completion of the scheme at fifteen years, during which time the farmers consequently should have to pay 30 cents per year a mow for flood protection work. Keeping in mind the losses inflicted by one single flood, as for instance the flood of 1915, when according to a very moderate estimation, property up to ten million dollars was destroyed, the population would, no doubt, take upon themselves the responsibility of paying a tax, provided guarantees were given that the tax would be efficiently and well spent for the purposes intended.

It is to be hoped that the leading corporations and men in this Province will have their eyes opened to the deplorable state into which the country has sunk through lack of efficient dyke maintenance, and will be made to understand the true bearing of the flood problem. What I have stated in this paper as to the condition of the rivers and their protection works are facts which cannot be denied, and the proposed remedy is based on sound technical suppositions. If I have been able to convince the public of the necessity of immediate steps being taken to straighten what has gone wrong, the purpose of this paper has been attained.

* * *

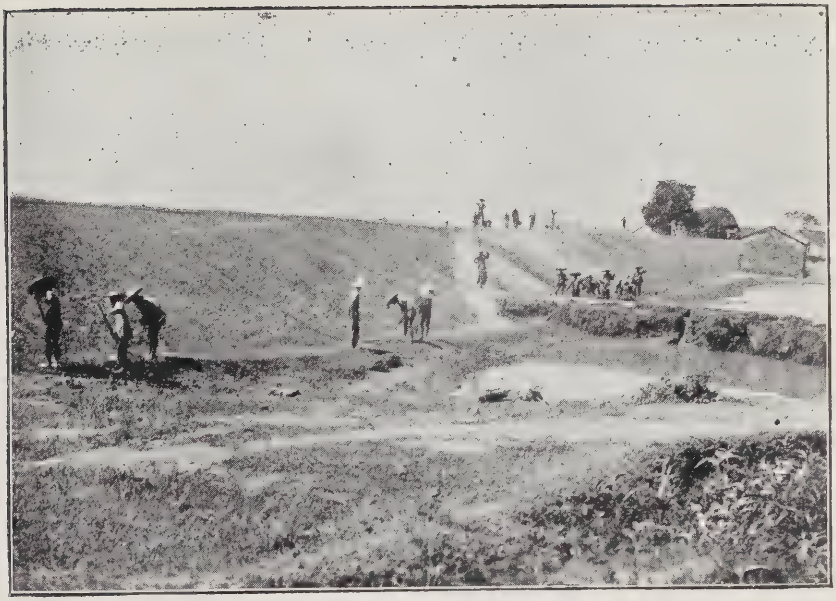

FIG. 1. A RECONSTRUCTED DYKE, EAST RIVER.

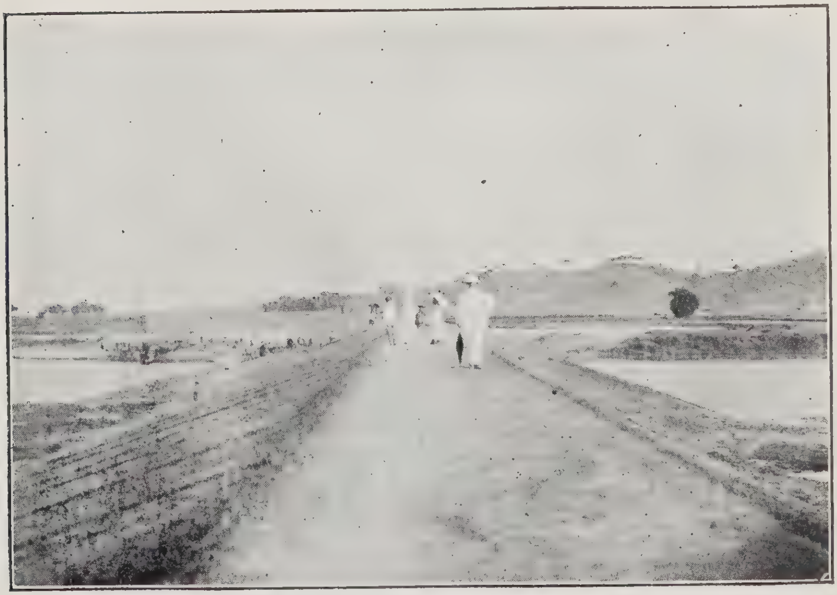

FIG. 2. A RECONSTRUCTED DYKE BEING INSPECTED BY THE ENGINEER-IN-CHIEF.

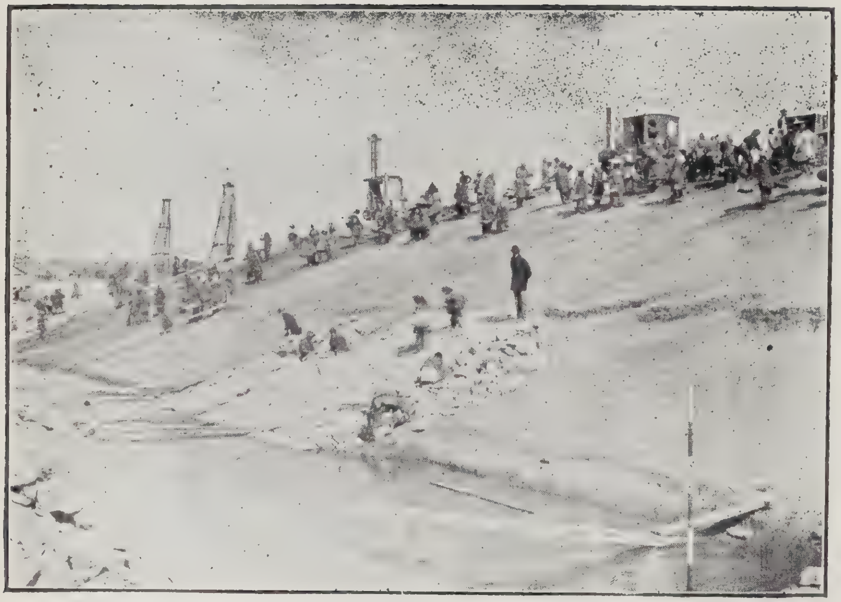

FIG. 3. STONE PITCHING ON DYKE SLOPE, NORTH RIVER.

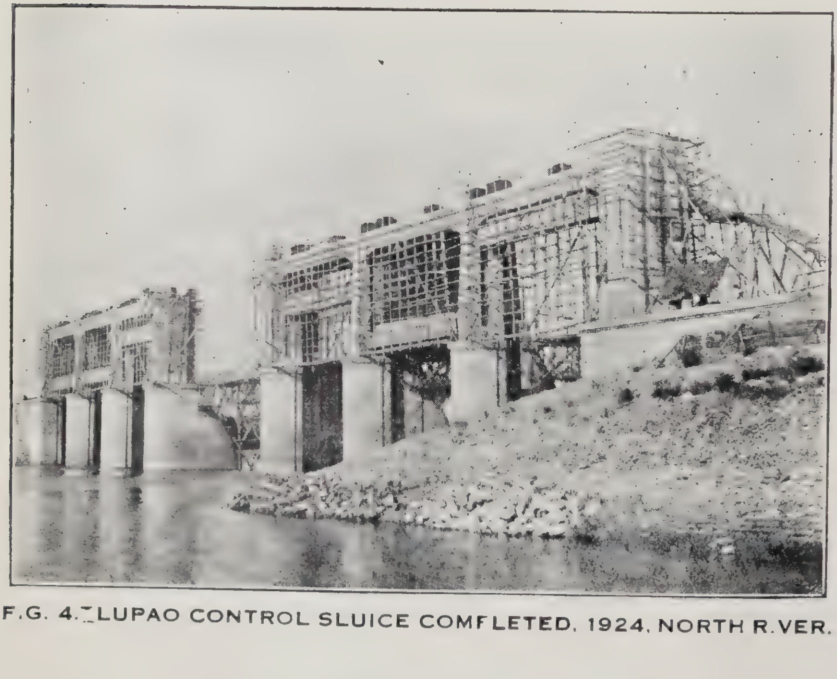

FIG. 4. LUPAO CONTROL SLUICE COMPLETED, 1924, NORTH RIVER.

AN EYE NEMATODE IN CHICKENS.

by

L. Hoh 何 亮

Ling Nan Agricultural Manufacturing Company.

In conducting chicken fattening tests at the Ling Nan Agricultural College, in the Spring of 1922, an eye nematode gave considerable trouble. A brief account of this parasite will be given in this paper.

A few days after the pullets for the first test had been purchased it was noted that the eyes on some were becoming badly swollen. Two pullets died, apparently from the trouble, on the 6th day after arriving at the College. During the next four days two more infected chickens died, and the eyelids of twenty-one birds were swollen so as to cause complete blindness. During this time a dilute solution of potassium permanganate was used to wash the eyes of all the chickens. The eyes of those affected were also washed daily with a boric acid solution. This treatment, however, did not seem in the least to check the trouble, although only one more chicken died. On the eighteenth day after purchase, and twelve days following the death of the first two pullets, a small thread like organism was found wriggling in the opaque, whitish fluid around the eyeball of a diseased chicken. The parasite was removed with tweesers, and on microscopic examination was found to be a member of the Nematoda, very likely *Filaria mansoni,* which was found and described by Sir Patrick Manson in Hongkong in the year 1878. Nematodes were also found in the affected eyes of several other chickens.

The genus *Filaria* is considered to be one of the most puzzling groups of animal parasites because of the peculiar metamorphosis it possesses, its manner of parasitizing, and the complex life cycle which it lives. The larvae of the *Filaria* are extremely minute in size, and grow to about 300 micrometers, or a little more than 1/100th of an inch in length, in the blood system of the host. The adults are slender nematodes from one tenth of an inch to a few inches in length. The individuals of this genus, which cause the serious human disease of elephantiasis, are members of the species *Filaria bancrofti.* One of the most important features of these creatures is that some of them can be transmitted from one host to another through the agency of the members of the *Culicidae* or the mosquitoes. If the form of nematodes found in the chickens was really the *Filaria mansoni* or species of the same genus, then the common Chinese conception: "A mosquito-bite causes the blindness of chickens," may have truth in it.

In the effort to secure a remedy for this desease of chickens, appeal was made to C. W. Howard, at that time Professor of Biology of the Canton Christian College. He recommended for treatment a two per cent solution of sodium bicarbonate, as a cleaning solution for bathing the diseased eyes every morning until the disease was checked. These formulas were presented in "The Parasitologie des Animaux Domestiques," by Dr. M. Neveau-Lemaire, in which the *Filaria mansoni* is described. Further studies should be carried out upon the nematode under consideration, and its actual identification determined. The application of cresol solution, of a little stronger than 2 per cent strength, for four days was enough to force the disease to show signs retreating, and within one week's time the diseased chickens had apparently completely recovered.

* * *

AGROMYZID FLY IN BEANS

by

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Canton Christian College

The Agromyzid flies are among the most common pests in the roots and stems of economic legume and grain plants. They are found in the warmer regions of Asia, Australia and Africa.

For a number of years it has been noticed that beans cannot be successfully grown to maturity on our campus when planted early in the fall. In the fall of 1921 the writer's attention was called to a larvae destroying the roots and stems of beans in the College Gardens. The effect on the plants was noticable before they were six inches high, and they were usually completely destroyed in a few days. A sort of gall, or knot of swollen tissue, formed near the point where the stem left the ground, the plants soon becoming yellow, and the stem rotted. It was noted that sometimes the knot of tissue formed a little below the ground. The root and stem became shredded, swollen, and dark brown; and it often became hollowed out, fibrous, and stringy. Only about five percent of the plants examined in the fields were free from the insect. The most serious condition was noted in string and lima beans.

In order to study the etiology a number of plants were examined with lenses and the tissues dissected out. Fly pupae were in all cases found, either buried away in the tissues on the inside of the stem, or on the outside attached to soil particles or to the swollen stem. Secondary infections of fungus of a *Mucor* type were found but only in material already partly injured. In a few instances a small nematode and *Collembola* were found. However, since none of these were constant they can hardly be considered to have played any part in the etiology of this infection. Pupae were seldom found more than one inch under ground. At most five pupae occurred in any one plant, three being the usual number. Evidently the pupae on each plant were from the eggs of only one adult.

Some pupae were isolated and the length of time for pupation studied. It was found that seventy-two hours, after the beginning of pupation in normal temperature conditions, sufficed for the change to adult form. Some took longer, but seventy-two hours is apparently the average. After emerging, the fly makes its way into the air through the broken parts of the stem, or through loose soil.

The pupae of these flies are characteristically elliptical in shape; the hind stigmata are situated upon small, rounded plates on the under side of the last segment. The abdomen is provided with false legs, without bristles.

After hatching, the flies were preserved, and later identified by Prof. M. Bezzi, of Turin, Italy. He writes in a letter dated January 22, 1921, "I have recognized the flies as *Agromyza phaseoli Coql.*, described in the Proc. Linn Soc. N. S. W. 1899, p. 129, from Australia, but found in Africa and India. Traggett called it the 'French Bean fly' in an article in the Ag. Gaz. N. S. W. 1911, with a plate, showing damage to plants."

Later it was determined that the larval stage lasted about five days from hatching. It is very difficult to recognize the young larvae or the eggs, but they soon grow larger, and in three days are easily determined.

The *Agromyzidae* are defined by Williston as flies with the front broad, with or without bristles. Antennae short, the third joint usually rounded, sometimes a little elongate or subquadrate; oral vibissae usually present. Arista bare or pubescent; never distinctly plumose, rarely wanting. Genitalia prominent. Wings broad, auxiliary vein vestigial or indistinct, never clearly separated, save sometimes in the proximal part, from the first vein. Second basal and anal cells always small, oftentimes indistinct, or the second basal united with the distal; cross-veins often much approximated, never very remote from each other. They are related to the Pomace-flies.

Agromyza phaseoli has been described as follows "Diskodal und hintere Basalzelle getrent, erstere langer als vodere Basalzelle. Hinterleib einforming, gewolbt."

It was not definitely determined how long the adults lived but, from knowledge of the time and other factors, it is thought that the adults soon mate and lay eggs in the plants. There is no evidence that they live longer than a few days. Damage by the insects at Canton Christian College occurs at only one season of the year, chiefly in September and October. It has not been found on any of the semi-wild legumes growing near the campus and is confined, so far as we have been able to observe, to cultivated plants. Eggs are carried over in the old stalks. The means of control will lie in carefully destroying all old bean stalks, and in practicing crop rotation with crops not attacked by the fly. Careful watch should be maintained over fields likely to harbor the flies, and beans should not be planted in such fields, or near them, until assurance can be given of freedom from flies or eggs.

AN ENUMERATION OF THE McCLURE COLLECTION OF HAINAN PLANTS*

G. W. Groff, Edward Ding and Elizabeth H. Groff,
Members of the Herbarium Committee,
Canton Christian College

257—Scrophulariaceae

257.7532—LIMNOPHILA AROMATICA (Lam.) Merr.

Nodoa (那大), 7739, Oct. 31, 1921 and *Kam Kong* (金江), 8723, Oct. 26, 1921; roadside, edge of rice paddy; herb; fls., maroon, purple; name reported, *Shui fa* (水花).

257.7536—ADENOSMA GLUTINOSUM (Linn.) Merr.

Nodoa (那大), 7942, Oct. 31, 1921; moist open grassy places; fls., purple, maroon.

257.7561—TORENIA GLABRA Osbeck
(T. BENTHAMIANA Hance)

Five Finger Mt., (五指嶺), 8465**, 8505, Dec. 22, 1921 and 8640, Dec. 24, 1921; wooded ravine, edge of rice field, in grass at side of path; alt., 700-900 m.; herb; fls., bright blue, purple.

257.7561—TORENIA HIRSUTA Lam.

Five Finger Mt., (五指嶺), 8529, Dec. 18, 1921 and 9587, May 14, 1922; edge of rice field; alt., 600 m.; herb; fls., purplish blue.

257.7562—LINDERNIA CRUSTACEA (Linn.) F. Muell.
(VANDELLIA CRUSTACEA)

Nodoa, Ha Kung Ling (那大,蝦公嶺), 8215, Nov. 21, 1921 and *Hainan, Ting On River* (海南,定安河), 8905**, Apr. 7, 1922; near hot spring, edge of moist rice paddies; alt., 300 m.; herb; ht., 50 m.; fls, light blue, lavender.

257.5762—LINDERNIA MOLLIS (Benth.) Wettst.

Nodoa, Heung Ling (那大, ?), 8209, Nov. 21, 1921 *Hainan, Tai Wan, San Hu* (海南,大環,新墟), 8938, Apr. 10, 1922; on terrace between rice fields; fls., lavender; name reported, *Hung kwat ts'o* (紅骨草).

257.7563—CURANGA FEL-TERRAE (Lour.) Merr.
(C. AMARA Juss.)

Hainan, Fan Ya (海南,番也), 9490, May 8, 1922; hillside; herb; fls., green.

*This is a continuation of the enumeration of the Hainan collection which appeared in Lingnaam agricultural review, v. 1 (1923), No. 2, pp. 27 86, v. 2 (1924), No. 1, pp. 9-44, and v. 2 (1924-25), No. 2, pp. 115-139.

The reader is also referred to Mr. F. A. McClure's article, Notes on the island of Hainan, in Lingnaam agricultural review, v. 1 (1922), No. 1, pp. 66-79 pl. 5, map.

257.7564—ILYSANTHES ANTIPODA (Linn.) Merr.

Hainan, Ting On River (海南,定安河), 8920, Apr. 8, 1922; alt., 60 m.

257.7564—ILYSANTHES CILIATA (Colsm.) O. Ktze.
(BONNAYA REPTANS Spreng.)

Hainan, T'a Hon, Nga Wan (海南,咄寒,牙環), 9235, Apr. 22, 1922; herb; fls., blue, lavender.

257.7576—SCOPARIA DULCIS Linn.

Hainan, Ting On River (海南,定安河), 8862, Apr. 6, 1922; sandy grassy bank; alt., 40 m.; ht., 1/3 m.; fls., white.

257.7622—BUCHNERA CRUCIATA Ham.

Hainan, N. of Fan Ta (海南.番打之北), 7767**, 9140, Apr. 18, 1922; in grass along road in dry places; herb; ht., 1/3-½ m.; fls., deep blue.

257.7625—STRIGA ASIATICA (Linn.) O. Ktze.
(S. LUTEA) Lour.

Nodoa (那大), 7936, Oct. 31, 1921, *Hainan, Kingchow* (海南.瓊州), 8831, Apr. 5, 1922 and *Hainan, Nga Wan, Yik T'sok Mau* (海南.牙環.亦作茂), 9259, Apr. 23, 1922; edge of wet paddy, roadside; alt., 10 m.; herb; dia., 10 cm.; fls., red, yellow; name reported, *Tuk keuk kam* (獨脚金).

258—Bignoniaceas

258.7700—OROXYLUM INDICUM (Linn.) Vent.

Nam Fung (南風), 8292, 1921; hillside forest; alt., 250 m.; tree; ht., 3 m.; dia., 20 cm.; name reported, *To pan tau shu* (刀板荳樹).

258.7741—DOLICHANDRONE CAUDAFELINA (Hance) Benth. & Hook. f.

Mai Kun Ts'un (米觀村), 7749, Oct. 24, 1921 and *Nodoa, Lin Fa Ling* (那大.蓮花嶺), 8057, Oct 2, 1921; roadside, dry places in village; alt., 250 m.; tree; ht., 7 m.; fls., yellow with maroon center; name reported, *Mau mi muk* (貓尾木).

258.7746—RADERMACHERA HAINANENSIS Merr. SP. NOV.
in PHILIP. JOURN. SCI. 21 (1922) 353.

Hoihow (海口), 7648, Oct. 12, 1921; dry sandy waste; tree; ht., 8 m.; dia., 15 cm.; fls., yellow; name reported, *Hung fa* (紅花).

259—Pedaliaceae

259.7777—SESAMUM ORIENTALE Linn.

Near On Yan (近安仁之地), 7799, Oct. 25, 1921; dry roadside; herb; fls., white; seeds yield oil used in cooking; name reported, *Yau ma* (油蔴).

261—Orobanchaceae

231.7789—AEGINETIA INDICA Linn.

Nodoa, Lin Fa Ling (那大,蓮花嶺), 8070, Nov. 3, 1921; moist bank in shade of tree; alt., 300 m.; herb; fls., maroon and pink.

262—Gesneriaceae

262.7808—OREOCHARIS FLAVIDA Merr. SP. NOV.
in PHILIP. JOURN. SCI. 21 (1922) 354.

Five Finger Mt., (五指嶺), 8598, Dec. 16, 1921; wooded mt. side on moist rock; alt., 1400 m.; fls., golden yellow.

262.7810—DIDYMOCARPUS SP.

Hainan, Yik Tsok Mau (海南,亦作茂), 9691, May 18, 1922; among leaf mold on rock in shady ravine; herb; fls., lavender, blue.

262.7824—TRICHOSPORUM MONINGERAE Merr.

T'a Hon (㘵寒), 8335, Dec. 5, 1921, *Five Finger Mt.*, (五指嶺), 8573, Dec. 12, 1921 and *Hainan* (海南), 9349, Apr. 28, 1922; wooded ravine at edge of stream, on tree in wooded ravine; alt., 375-1400 m.; shrub; ht., 3-4 m.; fls., red.

262.7841—RHYNCHOTECHUM LATIFOLIUM Hook. f. & Th.

Hainan, S. of Shui Mun (海南,水門之南部), 9600, May 14, 1922; wooded ravine; shrub; ht., 1/3-½ m.; fls., white.

264—Lentibulariaceae

264.7901—UTRICULARIA BIFIDA Linn.

Nodoa (那大), 7710, Oct. 28, 1921; rice paddy in water; alt., 250 m.; fls., yellow.

264.7901—UTRICULARIA FLEXUOSA Vahl.

Nodoa (那大), 7715, Oct. 28, 1921; rice paddy in water; alt., 250 m.; herb; fls., yellow.

266—Acanthaceae

266.7906—STAUROGYNE CONCINNULA (Hance) O. Ktze.

Five Finger Mt., (五指嶺), 9417, May 4, 1922; wooded ravine; herb; dia., 15-20 cm.; fls., green, maroon.

266.7914—THUNBERGIA FRAGRANS Roxb.

Nodoa, Pat Ka Ling (那大.筆架嶺), 8017, Oct. 28, 1921 and *Hainan, Kingchow* (海南,瓊州), 8837, Apr. 5, 1922; open dry hillside, grassy grave land; alt., 10-250 m.; ht., 1-2 m.; fls., white; name reported, *Lo a tsui* (老鴉嘴).

266.7914—THUNBERGIA SP.

Kingchow (瓊州), 7644, Oct. 14, 1921 and *Hainan, Kachek, Wong Chuk* (海南.嘉積 ?), 9801, June 1, 1922; on shrubs at roadside; vine; ht., 4-5 m.; fls., purple, light blue.

266.7926—HYGROPHILA SALICIFOLIA (Vahl.) Nees

Nodoa, Yau Ma Wo (那大,油蔴和), 7712, 7720**, 8115 Oct. 28, 1921; near stream; on rocks at edge of water; alt., 250 m.; herb; fls., lavender.

266.7951—STROBILANTHUS FLACCIDIFOLIUS Nees.

Five Finger Mt., Fan Ya (五指嶺.番也), 8444, Dec. 7, 1921; Lois garden; alt., 1000 m.; fls., light blue; branches and leaves used by Lois to make blue dye; name reported, *Tai lam tin* (大藍靛).

266.7951—STROBILANTHUS MACLUREI Merr. SP. NOV.
in PHILIP. JOURN. SCI. 21 (1922) 354.

Five Finger Mt., (五指嶺), 8480, Dec. 20, 1921, and 8578, Dec. 21, 1921; wooded ravine, mt. side forest; alt., 700-800 m.; bush; ht., 1/3-½ m.; fls., bluish lavender.

266.7951—STROBILANTHUS SP.

Nodoa, Sha Po Ling (那大,沙煲嶺), 8162, Nov. 11, 1921; edge of stream; alt., 400 m.; herb; fls., pale lavender.

266.7971—LEPIDAGATHIS HYALINA Nees.

Nam Fung (南風), 8261, Oct. 29, 1921 and *Ting On River* (定安河), 8850, Apr. 16, 1922; village commons, shady riverside; alt., 40-250 m.; herb; fls., lavender; white.

266.7973—BARLERIA CRISTATA Linn.

Hainan, Kingchow (海南,瓊州), 7553, Oct. 4, 1921; roadside; herb; prostrate; fls., blue.

266.8023—CODONACANTHUS PAUCIFLORUS Nees

Nodoa, Pat Ka Ling (那大,筆架嶺), 7901, Nov. 1, 1921, *Five Finger Mt., Fan Ya Ts'un* (五指嶺 番也村), 8442, Dec, 17, 1921 and 8632, Dec. 24, 1921; shady ravine on rockface; alt., 250-600 m.; herb; fls., white, lavender.

266.8024—PSEUDERANTHEMUM SP.
(ERANTHEMUM CRENULATUM Hemsl, Enum. non Wall.)

Hainan, Oo P'o, to Shuen P'o (海南, ?). 9772, May, 1922; on grassy half wooded hillside; ht., 1/4-½ m.; fls., white with lavender marking on large middle petal; somewhat woody plant.

266.8026—PERISTROPHE SP.

Five Finger Mt., (五指嶺), 8493, Dec. 23, 1921; wooded ravine; on rock face; herb; ht., 2/3 m.

266.8029—RUNGIA PARVIFLORA Nees

Nam Fung (南風), 8283, Nov. 30, 1921, *Five Finger Mt.*, (五指嶺), 8532, Dec. 18, 1921, 8550, Dec. 20,1921 and *Hainan, Ting On River* (海南,定安河), 8853, Apr. 6, 1922; in deep grassy hillside, open ravine at edge of rocks, in gravel near water, under trees; alt., 40-600 m.; herb; fls., light blue, faint lavender.

266.8031—DICLIPTERA CHINENSIS (Vahl.) Nees

Hoihow, Tai Tsing (海口,大井), 7752, Oct. 24, 1921; in ruins of old house; herb; fls., lavender; name reported, *Kau kon ts'oi* (九肝柴)

266.8065—CLINACANTUS NUTANS (Burm. f.) Lindan.

Five Finger Mt., (五指嶺), 8545, Dec. 20, 1921; moist shady places; alt., 600 m.; ht., 1/3-½ m.; fls., pink.

266.8080—STROPHACANTHUS SP.

Five Finger Mt., (五指嶺), 8618, Dec. 1921; wooded ravine; alt., 1200 m.; bush; ht., 1 m.; fls, light blue; indeterminable.

263.8094—JUSTICIA GENDARUSSA Burm. f.

Hainan, Yik Tsok Mau (海南,亦作茂), 9703, May 18, 1922; wooded ravine; shrub; ht., 1 m.; fls., white with slight tint of lavender on under side of petal.

266.8094—JUSTICIA SP.

N ar Fan Lun (近番掄), 9171, Apr. 19, 1922 and *Hainan, Sai Ching* (海南 西正), 9760, May 23, 1922; near stream, in Lois garden; shrub; ht., 1/3-1½ m.; fls., white; drug plant.

269—Plantaginaceae

239.8116—PLANTAGO MAJOR Linn.

Nodoa (那大), 7993, Nov. 20, 1921; roadside near village; alt., 250 m.; fls., greenish; drug plant; name reported, *Ts'in kun ts'o* (錢貫草).

270—Rubiaceae

270.8136—HEDYOTIS cf. AURICULARIA Linn

Nodoa (那大), 7959, Nov. 1, 1921; roadside; alt., 250 m.: herb.

270.8136—HEDYOTIS AURICULARIA Linn. var. fol MINORIBUS

Hainan, Kingchow (海南,瓊州), 8818, Apr. 5, 1922; roadside in waste place; herb; ht., 10 m.; fls., greenish, prostrate; name reported, *Chak u tam* (鯽魚膽).

270.8136—HEDYOTIS OLIGANTHA Merr. SP. NOV.
in PHILIP. JOURN. SCI. 23 (1923) 266.

Five Finger Mt., (五指嶺), 9401, May 1, 1922; in dense forest; bush; ht., 1/3 m.; fls., light blue to white.

270.8136—HEDYOTIS PINIFOLIA Wall.

Hainan, Ting On River (海南 定安河), 8903, Apr. 7, 1922; sandy waste; bush; ht., 50 m.; fls., white.

270.8136—HEDYOTIS SP.

Five Finger Mt., (五指嶺), 8522, Dec. 23, 1921; wooded ravine; alt., 800 m.; bush; ht., ½ m; fls., white.

270.8136—OLDENLANDIA BIFLORA Linn.

Nodoa, Pat Ka Ling (那大,筆架嶺), 8026. Nov. 1, 1921; edge of thicket; alt., 250 m.; herb.

270.8136—OLDENLANDIA DIFFUSA Roxb.

Hainan, Ting On River (海南定安河), 8901, Apr. 7, 1922; sandy waste; alt., 50 m.

270.8152—OPHIORRHIZA CANTONIENSIS Hance

Five Finger Mt., (五指嶺), 9419, May 4, 1922; wooded ravine near stream; herb; ht., 1 m.; fls., white.

270.8152—OPHIORRHIZA PUMILA Champ.

Hainan (海南), 9352, Apr. 28, 1922 and *Five Finger Mt.*, (五指嶺), 9481, May 7, 1922; on rocks in wooded ravine; herb; fls., white.

270.8152—OPHIORRHIZA SP.

Five Finger Mt., (五指嶺), 9344, Apr. 28, 1922; wooded ravine; herb; ht., 1/3 m.; fls., white.

270.8166—ARGOSTEMMA DISCOLOR Merr. SP. NOV.
in PHILIP. JOURN. SCI. 23 (1923) 265.

Five Finger Mt., (五指嶺), 9408, May 3, 1922; on moist shaded rock surfaces and fertile nooks; herb; fls., white.

270.8181—WENDLANDIA CHINENSIS Merr.

Hainan, Ting On River (海南定安河), 8907, Apr. 7, 1922 and *Five Finger Mt.*, (五指嶺), 9479, May 7, 1922; on river bank, in deep wooded ravine; alt., 50 m.; tree; ht., 1-12 m.; dia., 15 cm.; fls., bluish white, grey, green.

270.8226—ADINA PILULIFERA (Lam.) Franch.
(A. GLOBIFLORA Salisb.)

Nodoa (那大), 7926, Oct. 28, 1921 and *Five Finger Mt.*, (五指嶺), 9569, May 13, 1922; on shrubby mt. side; shrub; ht., 5 m.; dia., 10 cm.; fls., white.

270.8238—MUSSAENDA MEMBRANIFOLIA Merr. SP. NOV.
in PHILIP. JOURN. SCI. 23 (1923) 267.

Five Finger Mt., (五指嶺), 9316, Apr. 28, 1922; wooded ravine; vine; ht., 4-5 m.; fls., white.

270.8238—MUSSAENDA EROSA Champ.

Five Finger Mt., (五指嶺), 9555, May 13, 1922; vine; ht., 5-6 m.; fls., white.

270.8238—MUSSAENDA PUBESCENS Ait. f.

Near On Yan (近安仁之地), 7661, Oct. 25, 1921, *Near Lin Si, San Hu* (近 ? ,新墟), 7781, Oct. 28, 1921, *Nodoa, Yau Ma Wo* (那大,油蔴和), 8122, Nov. 11, 1921 and *Hainan, Fan Ya* (海南番也), 9308, Apr. 26, 1922; roadside among bushes, on shrubs in hillside thicket; alt., 250 m.; vine; ht., 2-4 m.; fls., yellow with white bract; names reported, *Pak chi shin* (白紙扇), *Pak mui* (白梅).

270.8238—MUSSAENDA HIRSUTULA Miq.

Near Tin Si, San Hu (近 ? ,新墟), 8256, Oct. 28, 1921; roadside; vine.

270.8278—TARENNA INCERTA Koord & Val.

Hainan, Yik Tsok Mau (海南 亦作茂), 9731, May 19, 1922; tree; ht, 15 m.; dia., 30 cm; fls., yellow; the wood of this tree is very hard and tough.

270.8283—RANDIA ACCEDENS Hance

Five Finger Mt., (五指嶺), 8651, Dec. 20, 1921; moist shady ravine; alt, 600 m.; shrub; ht., 2 m.; fls., yellowish green.

270.8283—RANDIA ACUMINATISSIMA Merr.

Five Finger Mt., (五指嶺), 8710, Dec. 20, 1921; moist shady ravine; alt., 600 m.; shrub; fls., white.

270.8283—RANDIA CAUDATIFOLIA Merr. SP. NOV.
in PHILIP. JOURN. SCI. 23 (1923) 268.

Five Finger Mt., (五指嶺), 9439, May 5, 1922 and 9564, May 13, 1922; heavily wooded steep mt. side, in wooded ravine; tree; ht., 10-11 m.; dia., 15 30 cm.; fls., white.

270.8283—RANDIA SINENSIS (Lour.) R. & S.

Hainan, Ting On River (海南 定安河), 8934, Apr. 9, 1922; alt., 70 m.; ht., 1-1½ m.; fls., white, fragrant.

270.8283—RANDIA SPINOSA (Thunb.) Blume
(R. DUMETORUM Lam.)

Hainan Kingchow (海南 瓊州), 7556, Oct. 14, 1921 and *Ting On River* (定安河), 8868, Apr. 6, 1922; thicket in rocky glen; alt., 40 m.; bush; ht., 2-3 m.; dia., 3-5 cm.; fls., first white then golden yellow; inside of fruits used to ward off land leeches by rubbing it on the exposed parts; names reported, *Shan p'o t'o* (山葡萄), *Ngau t'au lak* (牛頭竻), *Shan shek lau* (山石榴).

An economic specimen of this was secured on the Canton market under the name of *Shan p'o t'o* (山葡萄), C. C. C. Ec. No. 168. The price is about 50 cts. per catty L. S. It is quite common on the island of Honam which is opposite Canton city. Used externally. It is put in hot bath for mosquite and other bites. It is said to be the same as *Ngau t'au lak* (牛頭竻).

270.8283—RANDIA SP.

Five Finger Mt., (五指嶺), 9572, May 13, 1922; wooded ravine; shrub; ht., 1½ m; material too poor to determine.

270.8285—GARDENIA STENOPHYLLA Merr.

Hainan, T'a Hon, Nga Wan (海南 咃寒 牙環), 9239, Apr. 22, 1922; on rocky stream bank; shrub; ht., 1 m.; fls., white to cream, fragant.

270.8352—PLECTRONIA PARVIFOLIA (Roxb.) Kurz.

Hoihow (海口), 7586, Oct. 11, 1921, *Kam Kong* (金江), 7895, Oct. 26, 1921, *Nodoa, Pat Ka Ling* (那大,筆架嶺), 8016, Oct. 28, 1921 and *Ting On River* (定安河), 8935, Apr. 9, 1922; on graves, dry roadside, among shrubs, in thicket; alt., 70-250 m., bush; ht., 2/3-2 m.; fls., greenish yellow; frs., yellow.

270.8381—COFFEA ARABICA Linn.

Hainan, N. W. of Nodoa (海南西北之那大), 9816, Apr. 15, 1922; cultivated on hillside; shrub; ht., 2-2½ m.; frs., red when ripe; said to come from Java; called "Coffee robasta" by the grower; bears at 3 years old, yields 8 lbs. per tree; name reported, *Ho lan ka fi* (荷蘭咖啡).

270.8381—COFFEA LIBERICA Hiern.

Nodoa (那大), 9814, Apr. 15, 1922, cultivated on hillside; ht, 2½ 3 m.; frs., red, large; trees bear at 4 years old; yield 5-6 lbs. per mature tree; commercial coffee; fruits especially large; this variety is said to come from Singapore and will not stand any frost; called by the grower "Coffee stanophylla"; name reported, *Tai ka fi* (大咖啡).

270 8381—COFFEA ROBUSTA Linden.

Hainan, N. W. of Nodoa (海南那大之西北), 9815, Apr. 15, 1922; growing on hillside; shrub; ht., 2-2½ m.; frs., red when ripe; seeds came originally from Peru and S. America, called by the grower "Coffee arabia"; bears at 3 years old, yields about 8 lbs. per tree at maturity; name reported, *Pi lo ka fi* (秘嚕咖啡).

270.8383—PAVETTA INDICA Linn.

Nodoa, Lin Fa Ling (那大,蓮花嶺), 8089, Nov. 3, 1921; *Hainan, Tai Wan, San Hu* (海南,大環新墟), 8942, Apr. 10, 1922, *Hainan, Yik T'sok Mau, Fan Ya* (海南亦作茂.番也), 9277, Apr. 25, 1922 and *Hainan, S. E. of Shui Mun* (海南水門之東南部), 9601, May 14, 1922; moist shady ravine, in thinly wooded and shrubby waste land, among shrubs in ravine, on wooded mt. side; alt., 350 m.; shrub; ht, 2-3 m.; fls., white, fragrant.

270.8383—PAVETTA SP.

Five Finger Mt., Fan Ya Ts'un (五指嶺,番也村), 8428, Dec. 8, 1921 and 8441, Dec. 17, 1921; ravine, village commons; alt, 600-900 m.; bush; ht, 1-2 m.; frs., red berries.

270.8384—IXORA FULGENS Roxb.

Five Finger Mt., (五指嶺), 8684**, 9431, May 4, 1922 and 9445, May 5, 1922; wooded ravine; shrub; ht., 1½-2 m.; dia., 2 cm.

270.8384—IXORA PAVETTAEFOLIA (Kurz) Craib.

Five Finger Mt., Fan Ya Ts'un (五指嶺,番也村), 8405, Dec. 1921 and *Five Finger Mt.,* (五指嶺), 8726, Dec. 15, 1921; wooded mt. side; alt., 1000 m.; shrub; ht., 2 m.; frs., black.

270.8384—IXORA SP.

Nodoa, Lin Fa Ling (那大蓮花嶺), 8081, 8086, Nov. 3, 1921, '*Ka La* (加拉), 8328, Dec 4, 1921 and *T'a Hon, Nga Wan* (他寒.牙環), 9233, Apr. 22, 1922; thicket, edge of ravine, among rocks at edge of stream; alt., 280-350 m.; shrub; ht., 1-2½ m.; fls., red.

270.8399—PSYCHOTRIA HENRYI Lev.

Five Finger Mt., (五指嶺), 8617, Dec. 23, 1921, 9341, Apr. 28, 1922, 9453, May 5, 1922 and 9304, May 14, 1922; wooded mt. side. in wooded ravine in rich soil, among rocks., edge of stream in heavily wooded ravine; alt., 1200 m.; bush; ht., ½-3 m.; fls., white; frs., bright red.

270.8399—PSYCHOTRIA IXOROIDES Barth.

Five Finger Mt., (五指嶺), 9477, May 7, 1922 and 9575, May 13, 1922; growing on trunk, in wooded ravine; vine; ht., 7-15 m.; dia., 2 cm.; fls., cream, white.

270.8399—PSYCHOTRIA REEVESII Wall.
(P. ELLIPTICA Ker.)

Kingchow (瓊州), 7530, Oct. 14, 1921, *Five Finger Mt.*, (五嶺嶺), 8443, Dec. 7, 1921, *Hainan, Kingchow* (海南.瓊州), 8807, Apr. 5, 1922 and *Hainan, Ting On River* (海南.定安河), 8879, Apr. 6, 1922; dry grassy places, hillside, roadside, among trees in waste places, in moist wooded ravine; alt., 40-1000 m.; bush; ht., 1-2 m.; fls., white, yellowish; frs., yellowish-red; drug plant; names reported, *Cu'ui lung kon* (吹龍桿), *Shan ta tai to* (山打大刀).

270.8399—PSYCHOTRIA STRAMINEA Hutch.

Hainan (海南), 9339, Apr. 28, 1922 and *Yik Tsok Mau* (亦作茂), 9696, May 18, 1922; wooded ravine; shrub; ht., 1 m.; fls., yellowish green.

270.8405—CHASALIA CURVIFORA (Wall) Thw.

Five Finger Mt., (五指嶺), 8565, Dec. 15, 1921, 8709, Dec. 20, 1921, *Hainan, T'a Hon, Nga Wan, Five Finger Mt.*, (海南,他寒,牙環.五指嶺), 9229, 9403, 9406, May 3, 1922 and 9466, May 6, 1922; wooded ravine, wooded mt. side; alt., 700-1200 m.; shrub; ht., 1-2 m.; dia., 1½ cm.; fls., lavender, white; frs., black, yellow.

270.8410—GEOPHILA HERBACEA (Linn) O. Ktz.

7722**

270.8412—LASIANTHUS CALYCINUS Dunn.

Five Finger Mt., (五指嶺), 8498, Dec. 23, 1921 and 8661, Dec. 9, 1921; wooded ravine; alt., 1000 m.; shrub; ht., 3, m.; fls., white.

270.8412—LASIANTHUS CHINENSIS Benth.

Five Finger Mt., Fan Ya (五指嶺.番也), 8450, Dec. 7, 1921, *Five Finger Mt.*, (五指嶺), 8549, Dec. 20, 1921, 8700, Dec. 20, 1921 and *Hainan, T'a Hon.* to *Nga Wan* (海南.咃寒到牙環), 9234, Apr. 22, 1922; hillside, mt. side forest; alt., 700-1000 m.; shrub; ht., 1½-3 m.; dia., 1½-6 cm.; fls., yellow, white; frs., black; name reported, *Kai shi shu* (雞屎樹).

270 8412—LASIANTHUS CYANOCARPUS Jack

Five Finger Mt., (五指嶺), 9565, May 13, 1922; wooded ravine; shrub; ht., 1½ m.; fls., blue.

270.8412—LASIANTHUS FORDII Hemsl.

Nodoa, Sha Po Ling (那大,沙煲嶺), 8155, Nov. 10, 1921 and 8203, Nov. 11, 1921; mt. side thicket, grassy hillside; alt., 450-800 m.; shrub; ht., 1-5 m.; fls., white; frs., light blue.

270.8412—LASIANTHUS HAINANENSIS Merr. SP. NOV.
in PHILIP. JOURN. SCI. 21 (1922) 355.

Five Finger Mt., (五指嶺), 8569, Dec. 15, 1921 and 9451, May 5, 1922; wooded ravine on tree; alt., 1200 m.; vine; ht., 2 m.; dia., 1½ cm.; fls., white; frs., orange yellow, edible; good for oramental.

270.8412—LASIANTHUS cf. LOWIANUS King & Gamble

Five Finger Mt., (五指嶺), 8564, Dec. 13, 1921; wooded ravine; alt., 1400 m.; shrub; ht., 2-3 m.; frs., deep blue.

270.8412—LASIANTHUS OBLIQUINERVIS Merr.

Hainan, Yik Tsok Mau (海南,亦作茂), 9671, May 18, 1922; wooded ravine; shrub; ht., 2-2½ m.; dia., 2 cm.

270.8412—LASIANTHUS SP.

Hainan, enroute T'a Hon, Nga Wan (海南,吔寒,牙環), 9227, Apr. 22, 1922; in moist wooded ravine; tree; ht., 2 m.; fls., white.

270.8412—LASIANTHUS SP.

Five Finger Mt., (五指嶺), 9547, May 13, 1922; in heavy forest; shrub; ht., 1½ m.; fls., white.

270.8412—LASIANTHUS SP.

Five Finger Mt., (五指嶺), 9574, May 13, 1922; wooded ravine; shrub; ht., 1½ m.; fls., purplish white.

270.8413—LITHOSANTHES BIFLORA Blume

Five Finger Mt., (五指嶺), 8708, Dec. 20, 1921; wooded mt. side; alt., 700 m.; shrub; ht., 2 m; frs., black.

270.8418—SAPROSMA TERNATUM (Wall.) Hook f.

Five Finger Mt., (五指嶺). 8551, Dec. 20, 1921, 8571, Dec. 15, 1921, 8604, Dec. 16, 1921, 8662, Dec. 9, 1921, 9310, 9351, Apr. 28, 1922 and 9456, May 5, 1922; mt. side forest, wooded ravine; edge of stream; alt., 700-1400 m.; shrub; ht., 2-5 m.; dia., 3-8 cm.; fls., white, some with purplish tinge; frs., black.

270.8418—SAPROSMA SP.

Five Finger Mt., Fan Ya (五指嶺,番也), 8380, Dec. 10, 1921; moist shady ravine; alt., 1200 m.; shrub; ht., 2 m.

270.8430—PAEDERIA FOETIDA Linn.

Nodoa (那大), 7929, Oct. 31, 1921, *Nodoa, Lin Fa Ling* (那大,蓮花嶺), 8088, Nov. 3, 1921 and *Fan Ya* (番也), 9303, Apr. 26, 1922; on bushes along stream, dry roadside, on shrubs; alt., 250 m.; vine; ht, 2-3 m.; fls., yellow on margin, red inside, have unpleasant odor; name reported, *Kai shi t'ang* (鷄屎藤).

270.8461—PRISMATOMERIS TETRANDRA (Roxb.) K. Schum.

Five Finger Mt., Fan Ya (五指嶺,番也), 8415, Dec. 9, 1921 and *Five Finger Mt.*, (五指嶺), 8490, Dec. 23, 1921, 8594, Dec. 16, 1921, 9407, May 3, 1922 and 9426, May 4, 1922; mt. side forest, wooded ravine; alt., 800-1400 m.; shrub; ht., 1-4 m.; dia., 3-5 cm.; fls., white; frs., purplish black.

270 8463—MORINDA PARVIFOLIA Bartl.

Hainan, Kingchow (海南,瓊州), 8826, Apr. 5, 1922; on shrub at roadside; alt., 10 m.; ht., 7-10 m.: fls., white with yellow center, slightly fragrant; drug plant; name reported, *Lai t'in kung* (黎田公).

270.8463—MORINDA TRICHOPHYLLA Merr. SP. NOV.
in PHILIP. JOURN. SCI. 23 (1923) 267.

Hainan, Yik Tsok Mau (海南.亦作茂). 9668 May 17, 1922; 9755, May 19, 1922; on large tree in partially wooded ravine; vine; ht., 8-10 m.; dia., 1-1½ cm.; fls., green, white.

270.8463—MORINDA UMBELATA Linn.

Hainan, near Tin Si (海南 近 ?), 8974, Apr. 11 1922 and *Hainan, T'a Hon, Nga Wan* (海南 咃寒 牙環), 9250, Apr. 22, 1922; on shrubs in waste land, on hillside thicket; vine; ht., ½-5 m; fls., white, orange; names reported, *Ngau kok t'ang* (牛角藤), *Yeung kok t'ang* (羊角藤).

270.8473—BORRERIA HISPIDA (Linn.) K. Schum.

Hoihow (海口), 7583, 8583**, Oct. 12, 1921, and *Hainan, Ting On River* (海南 定安河), 8893, Apr. 7, 1922; sandy grassy field, sandy waste; herb; fls., blue, lavender; name reported, *Ts'o chat ts'o* (草卒草)

270 8473—BORRERIA STRICTA (Linn f.) G. F. W. Mey.

Nodoa (那大), 7738, Oct. 31, 1921; dry grassless slope; herb.

270.8189—RUBIA CORDIFOLIA Linn

Nodoa (那大). 7972. 7992, Nov. 14, 1921, *Hong Ma Ts'un* (康馬村). 8295, Dec. 3, 1921 and *Hainan, Shui Mun* (海南.水門), 9610, May 15, 1922; on shrubs in thicket, in shady ravine, on bushes at roadside; alt., 250-400 m.; vine; ht., 1½ 2 m.; fls., yellowish white; frs., black.

270 ?

Hainan. Kachek, Wong Chuk (海南.嘉積, ?). 9783, June 1, 1922; on shrubs at roadside; vine; ht., 4-5 m.

271—Caprifoliaceae

271.8515—SAMBUCUS JAVANICA Blume

Hainan, Fan Ya (海南 番也), 9630, May 15, 1922; open ravine; herb; ht., 1½ m.; fls., yellow when open.

271.8523—LONICERA AFFINIS H. & A. var. PUBESCENS Maxim.

Hainan, near Notia (海南 近和舍), 7945**, and 8937, Apr. 10, 1922; in thickets and on shrubs in waste land; alt., 80 m.; ht., 2 3 m.; fls., white to yellow, very fragrant; drug plant, water in which leaves and flowers have been steeped is good for itchy rash; tea made from the same and honey good for boils; name reported, *Kam ngan fa* (金銀花).

Economic specimen secured on the Canton market by E. H. Groff, C. C. C. Ec. No. 160 under the name of *Kam ngan fa* (金銀花). It is reported used in Canton the same as in Hainan.

271.8523—LONICERA MACRANTHA DC.

Hainan, near Fan Ya (海南,近番也), 9528, May 10, 1922; on shrubs at roadside; vine; ht., 3-4 m.; frs., white when approaching maturity, lavender to pink when ripe.

275—Cucurbitaceae

275.8552—HEMSLEYA SP. aff. TRIFOLIATA Cogn.

Five Finger Mt., (五指嶺), 9309, Apr. 28, 1922; wooded ravine; ht., 1-2 m.

275.8562—MELOTHRIA HETEROPHYLLA (Lour.) Cogn.

Near Ka La (近加拉之地), 9186, Apr. 20, 1922; on shrubs in ravine; vine; ht., 1-2 m.; fls., yellow; name reported, *Mau kwa* (茅瓜).

275.8562—MELOTHRIA INDICA Lour.

Hoihow (海口), 7635, Oct. 10, 1921, *Hoihow, Tai Tsing* (海口,大井), 7824, Oct. 24, 1921 and *Hainan, near Tau Ti P'o* (海南,近 ?). 9825, Apr. 18, 1922; dry thicket, on bamboo by roadside, on bushes at roadside; vine; ht., 1-2 m.; fls., white; names reported, *Lo shu tung kwa* (老鼠冬瓜), *Ka miu kwa* (假苗瓜), *Lo shu lai tung kwa* (老鼠拉冬瓜).

275.8562—MELOTHRIA JAVANICA (Miq.) Cogn.

Nodoa, Sha Po Ling (那大,沙煲嶺), 8191, Nov. 11, 1921; on grass at edge of stream; alt., 400 m.; fls., yellow; frs., red.

275.8562—MELOTHRIA MUCRONATA (Blume) Cogn.

Nodoa, Sha Po Ling (那大.沙煲嶺), 8172, Nov. 10, 1921; thicket at summit; vine; frs., berries, brownish black when ripe.

275.8562—MELOTHRIA MADERUSPATANA Cogn.
(MUKIA SCABRELLA Arn.)

Nodoa, Lin Fa Ling (那大.蓮花嶺), 7913, Nov. 3, 1921; mt. side; vine; ht., 1 m.; frs., red.

275.8591—MOMORDICA COCHINCHINENSIS (Lour.) Spreng.

Near Mai Kun Ts'un (近米觀村之地), 7665 and 8231, Oct. 25, 1921; roadside on wall; vine; fls., light blue; green frs., with white stripes, green with red stripes when ripe, 270.8594—LUFFA CYLINDRICA (Linn.) Roem.

Five Finger Mt., (五指嶺), 8638, Dec. 24, 1921; grassy ravine; alt., 600 m.; vine; ht., 2 m.; fls, yellow.

275.8607—GYMNOPETALUM CHINENSE (Lour.) Merr.

Nodoa, near Pat Ka Ling (那大,近筆架嶺), 7903, Nov. 1, 1921; on shrubs in thicket; vine; frs., red, orange.

275 8307—GYMNOPETALUM INTEGRIFOLIUM Kurz.

Hoihow (海口), 7639, Oct. 11, 1921: among graves; vine; fls., white.

275.8615—TRICHOSANTHES KIRILOWII Maxim

Kingchow (瓊州), 7628, Oct. 14, 1921; dry land; vine; fls., white.

275.8615—TRICHOSANTHES PUNCTATA Hayata

Five Finger Mt., (五指嶺), 8533, Dec. 18, 1921; in tall grass at edge of mt. stream; alt., 600 m.; vine; frs., yellow when ripe.

275.8622—CUCURBITA MAXIMA Duch.

Hainan, Fan Ya (海南 番也), 9288, Apr. 26, 1922; in Loi garden: ht., 4-5 m., fls., gold yellow; frs., very rich yellow inside and very sweet in flavor. outside yellow streaked with white when ripe; cultivated by Lois; names reported, *Fan kwa* (番瓜), *Kam kwa* (金瓜).

275.8628—COCCINA CORDIFOLIA (Linn.) Cogn.
(CEPHALANDRA INDICA Naud)

Hoihow (海口), 7638, Oct. 11, 1921, 7615, Oct. 9, 1921 and *Tung Shan on Ting On River* (? ,定安河), 8912, Apr. 8, 1922; top of city wall, on trees and bamboo on bank; alt., 50 m.; vine; ht., 4-5 m.; dia., 1½ cm.; fls., white frs., yellowish red; names reported, *Fung kwa* (鳳瓜), *Hung kwa* (紅瓜), *Lo a tsoi* (老鴉菜).

276—Campanulaceae

276.8657—CAMPANUMOEA LANCIFOLIA (Blume) Comb. Nov.
(C. TRUNCATA Endl)

Five Finger Mt., (五指嶺), 8576, Dec. 21, 1921; mt. side forest; alt., 700 m.; shrub; ht., 2 m.; frs., purple.

276.8679—PENTAPHRAGMA SPICATUM Merr. SP. NOV.
in PHILIP. JOURN. SCI. 21 (1922) 511.

Five Finger Mt., (五指嶺), 8675, Dec. 13, 1921 and 9337, Apr. 28, 1922; wooded ravine, moist shady ravine in rich soil; alt., 1400 m.; herb; fls., white; leaves sometimes eaten by Lois as vegetable.

276.8694—LOBELIA CHINENSIS Lour.

Nodoa (那大), 7714, 7827**, Oct. 28, 1921; grassy moist habitat; alt., 250 m.; herb; fls., blue.

276.8698—PRATIA NUMMULARIA (Lam.) Kurz.

Five Finger Mt., Fan Ya Ts'un (五指嶺,番也村), 8410, Dec. 1921 and 8434, Dec. 11, 1921; shady bank, village commons; alt., 600-1000 m.; vine; frs., purple, maroon.

276.8698—PRATIA SP.

Five Finger Mt., (五指嶺), 9350, Apr. 28, 1922; edge of stream in wooded ravine; herb.

280—Compositae

280.8751—VERNONIA ANDERSONII C. B. Clarke.

Nodoa, Pat Ka Ling (那大,筆架嶺), 8022, Oct. 28, 1921 and *Five Finger Mt., Yik Tsok Mau* (五指嶺,亦作茂), 8464, Dec. 24, 1921; edge of thicket, open ravine on rock; alt., 250 m.; vine; ht., 2-3 m.; fls., maroon, white.

280.8751—VERNONIA PATULA (Ait.) Merr.

Hoihow (海口), 7632, Oct. 9, 1921; roadside; herb; ht, ½ m.; fls., purple.

280.8751—VERNONIA TERES Wall.

Nodoa, Sha Po Ling (那大,沙煲嶺), 8158a, Nov. 11, 1921 and *Nodoa* (那大), 8274, Nov. 28, 1921; grassy slope, roadside; alt., 250-450 m.; herb; ht., 2/3-1 m.; fls., blue, lavender; name reported, *Luk yut shut* (六月雪).

280.8775—ELEPHANTOPUS SCABER Linn.

Hoihow (海口), 7567, Oct. 11, 1921; shady mound; herb; fls., white; name reported, *Tin kai tsoi* (天芥菜).

230.8785—ADENOSTEMMA LAVENIA (Linn.) O. Ktze.

Nodoa (那大), 7934, Oct. 31, 1921; moist, shady places; herb; fls., white.

280.8865—GRANGEA MADERASPATANA (Linn.) Poir.

Hainan, Ting On River (海南,定安河), 8902, Apr. 7, 1922; in sandy cultivated fields; alt., 50 m.; fls., yellow.

280.8900—ASTER GERLACHII Hance

Nodoa, near Pat Ka Ling (那大,近筆架嶺), 7850, Nov. 1, 1921; dry grassy places; herb; fls., white; name reported, *Shan pak kuk* (山白菊).

280.8921—MICROGLOSSA VOLUBILIS (Wall.) DC.

Nodoa (那大), 7950, Nov. 9, 1921 and *Hainan near Nam Fung* (海南 近南風), 9823, Apr 17, 1922; on bushes at roadside; alt., 250 m.; vine; ht., 2-3 m.; fls., white; name reported, *Kau li ming* (九里明).

280.8939—BLUMEA BALSAMIFERA (Linn.) DC.

Hainan, Fan Ta (海南,番打), 9154, Apr. 18, 1922; village commons; shrub; ht., 3 4 m.: fls., yellow; drug plant; the soft fragrant leaves are used by Lois in place of a towel to wipe sweat from their faces; tea made of leaves used as a wash in the treatment of dropsy; name reported, *Hok lo ma* (鶴老蔴).

A specimen of this was secured on the Canton market by E. H. Groff under the name of *Hok lo ma* (鶴老蔴), C. C. C. Ec. No. 169. It sells for about 20 cts. per catty L. S. and is used in the form of a wash for itching.

280.8939—BLUMEA LACERA DC.

Near Fan Lun (近番掄之地), 9174, Apr. 19, 1922; on grass terrace; herb; ht., 1 m.; fls., lavender; frs., white.

280.8941—PLUCHEA INDICA (Linn.) Less.

Hoihow (海口), 7617, Oct. 10, 1921; dry ground; bush; ht., 2/3 m.; fls., yellowish white, fragrant.

280 8955—SPHAERANTHUS AFRICANUS Linn.

Nodoa, Pat Ka Ling (那大,筆架嶺), 7855, Nov. 1, 1921; edge of rice paddy; herb.

280.8992—GNAPHALIUM HYPOLEUCUM DC.

Five Finger Mt., (五指嶺), 8511, Dec. 22 1922; mt. side grassy place; herb; ht., 2/3 m.; fls., yellow; name reported, *Wong fa ngai* (黃花艾).

280.8992—GNAPHALIUM INDICUM Linn.

Hainan, Ka La (海南.加拉), 8806, Apr. 21, 1921; wooded ravine; dia., 1½-2 cm.; frs., orange yellow when ripe; name reported, *Wong fa ngai* (黃花艾).

280.9096—ANISOPAPPUS CHINENSIS (Linn.) H. & A.

Tin Si (?), 7785, Oct. 28, 1921; dry roadside; herb; fls., yellow; name reported, *Shan wong kuk* (山黃菊).

280.9166—ECLIPTA ALBA (Linn.) Hassk.

Hoihow (海口), 7554, Oct. 12, 1921; dry rice field; herb; fls., white; name reported, *Pak fa pang k'i kuk* (白花蟛蜞菊).

280.9192—WEDELIA BIFLORA (Linn.) DC.

Hoihow (海口), 7559, Oct. 10, 1921; edge of wet thicket; vine; fls., yellow; name reported, *Kau li ming* (九里明).

280.9224—SYNEDRELLA NODIFLORA (Linn.) Gaertn.

Nodoa, Lin Fa Ling (那大.蓮花嶺), 8077, Nov. 3, 1921; hillside, edge of shrubby thicket; herb; fls., yellow.

230 9237—BIDENS PILOSA Linn.

Hainan, Kingchow (海南,瓊州), 7550, Oct. 14, 1921 and 8808, Apr. 5, 1922; grassy field, roadside; alt., 10 m.; fls., yellow; drug plant; name reported, *Kam pun ngan chan* (金盆銀盞).

An economic specimen of this was purchased on the Canton market by E H. Groff under the name of *Kam pun ngan chan* (金盆銀盞), C. C. C. Ec. No. 170. The price is about 2-cts. per catty L. S. It is used with other ingredients to make a tea for fever.

280.9358—ARTEMISIA JAPONICA Thunb.

Nodoa (那大), 7764, Nov. 1, 1921; edge of field; alt., 250 m.; herb; fls., white.

280 9358—ARTEMISIA VULGARIS Linn.

Hainan, Kingchow (海南.瓊州), 7531, Oct. 14, 1921; thicket; herb; ht., 1 m; fls., white.

280.9389—ERECHTITES VALERIANAEFOLIA (Wolf.) DC.

Hainan, near Tau Ti P'o (海南, ?), 9128, Apr. 18, 1922; along stream in shade; herb; ht., 1 m.; frs., white.

280.9405—GYNURA BICOLOR (Roxb.) DC.

Hainan, S. of near Tau Ti P'o (海南, ?), 9131, Apr. 18. 1922: grassy hill; herb; ht., ½ m.; fls., yellow; name reported, *Hung pui ts'oi* (紅背菜).

230.9405—GYNURA DIVARICATA (Linn.) DC.

Hoihow (海口), 7528, Oct. 12, 1921, *Five Finger Mt.*, (五指嶺), 8459, Dec. 7, 1921 and *Kingchow* (瓊州), 8811, Apr. 5, 1922; edge of bamboo thicket, hillside, grassy roadside; alt., 10-1000 m.; ht., 1/3-1 m.; fls., yellow, reddish orange.

280.9405—GYNURA MACLUREI Merr. SP. NOV.
in PHILIP. JOURN. SCI. 21 (1922) 355.

Five Finger Mt., (五指嶺), 8588, Dec. 21, 1921 and 8626, Dec. 1921; mt. side forest on rock, on burned over hills; alt., 600-750 m.; herb; ht., 2/3 m.; fls., yellow.

280.9411—EMILIA SONCHIFOLIA (Linn.) DC.

Hainan, Kingchow (海南,瓊州), 8809, Apr. 5, 1922; roadside; fls, reddish seed, wings white; drug plant; names reported, *Hung pui ts'oi* (紅背菜), *Yeung t'ai ts'oi* (揚蹄菜).

An economic specimen of this was secured on the Canton market by E. H Groff under the name of *Hung pui ts'oi* (紅背菜), C. C. C. Ec. No. 171. The cost is about 40 cts. per catty L. S. It is found on Honam Island opposite Canton. It is said to be used to make tea which is drunk for fever.

280.9479—CNICUS JAPONICUS (DC.) Maxim.

Near On Yan (近安仁), 8233, Oct. 25, 1921 and *Hainan, Kingchow* (海南.瓊州), 8813, Apr. 5, 1922; grassy roadside; alt., 10 m.; ht., 1/3 m.; fls., lavender; drug plant; name reported, *Po kung ying* (蒲公英).

280.9513—AINSLIAEA PTEROPODA DC. var.
8536**

280.9528—GERBERA PILOSELLOIDES Cass.

S. of Nam Fung, Hong Ma Ts'un (南風之南,康馬村), 8303, Dec. 2, 1921 and *Five Finger Mt.*, (五指嶺), 8622, Dec. 1921; open hillside in burned places; places; alt., 350-400 m.; herb; fls., white or slightly pink.

280.9593—LACTUCA CHINENSIS (Thunb.) Makino
(L. VERSICOLOR)

Hoihow, Tai Tsing (海口,大井), 7821, Oct 25. 1921 and *Hainan, Kingchow* (海南,瓊州), 8827, Apr. 5, 1922; edge of cultivated field, grassy roadside; alt., 10 m.; herb; fls., yellow; name reported, *Shan fu mak* (山苦麥).

280.9593—LACTUCA ELATA Hemsl.

Five Finger Mt., (五指嶺), 9561, May 13, 1922; herb; fls., lavender, red; frs., white.

280.9593—LACTUCA REPENS (Linn.) Maxim.

Five Finger Mt., (五指嶺), 8514, Dec. 1921; wooded ravine; vine; fls., yellow.

280.9695—CREPIS JAPONICA (Thunb.) Benth

Five Finger Mt., (五指嶺), 8557, Dec. 20, 1921; moist wooded ravine; alt., 600 m.; herb; fls., yellow.

UNIDENTIFIED SPECIES:

Nam Fung (南風), 8287, Nov. 30, 1921, *Five Finger Mt.*, (五指嶺), 8542, Dec. 19, 1921 and 9331, Apr. 28, 1922, *Fan Ya* (番也), 9291, Apr. 26, 1922 and *Yik Tsok Mau* (亦作茂), 9723, 9752, May 19, 1922; edge of small stream, on tree, in garden, in moist wooded ravine; alt., 300-600 m.: tree, vine, herb; dia., 12-50 cm.; frs., red and pink; no flower or fruit at this season, leaves eaten, low moss-like plant, available commercial wood.

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A STUDY OF THE GROWTH-RATE OF SQUARE BAMBOO

by

William M. Porterfield

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In no group of the plant kingdom have there been found such instances of rapid growth as is found among the bamboos. As we have elsewhere shown (1) the culms of a grove are but different branches of the same plant. It is when the shoots or young culms begin to elongate after pushing their way up through the soil that the most rapid growth takes place. In the introduction to his paper on the elongation of bamboo culms, G. Kraus (2) has summarized the work of previous observers dating from 1833 on the rate of growth. Very little was done except marking up the daily measurements and drawing the curve. Data on temperature, moisture, soil, climate, or general environment which might have shed light on the factors governing growth were not collected. Kraus was the first to try to show correlation between growth and environment. His findings seem to differ, however, from those of subsequent investigators. Whether from faculty technique or from inaccurate observation it is hard to say. But certain it is from the readings on daily growth that at least his shoots acted in a very peculiar way and, moreover, quite differently from those of Lock, Shibata, and our own. Apparently after growing smoothly enough to a certain height they began to show irregularities and to grow by jumps. Culms furthermore which were attached to the same rhizome, instead of jumping together in the same direction, seemed to have an individuality all their own and often jumped in opposite directions. Kraus claims this as evidence of their physiological independence. But we believe that there is ample evidence to prove that there is no such independence of the culms. These irregularities of growth which varied so among culms thus connected, Kraus asserted, could not be ascribed to environment in any sense of the word since in the latter case all culms would be subject to the same conditions and would, therefore, all react in the same way.

Lock (3) nearly ten years later working in Ceylon concluded from his study of the growth of giant bamboos that the curve of growth by day follows closely that of the percentage of moisture in the air. Shibata (4) in his study of the rate of growth showed general similarity in the growth-rate of his six culms. Furthermore the curves agree with that of the mean daily temperature. Certainly from our present extensive knowledge of the relations of plants to their respective environments, it is a most logical and natural conclusion to reach that in the special case of bamboos also their growth is influenced by temperature, moisture, and general climatic conditions.

From our own work let us see what conclusions we reach. A patch of square bamboo, *Phyllostachys quadrangularis* on the St. John's University grounds, hidden and more or less sheltered from prying persons by a heavy screen of shrubs and low trees, was conveniently situated for daily observations. The shoots made their appearance above ground in the latter part of October (5) and measurements were begun immediately. Three shoots were selected for observation. For each shoot a meter stick was screwed on to a movable block of heavy wood or section of log so that, in position beside the shoot, the lower end barely rested on the surface of the ground. In this way the zero point was aways the same and possible mistakes in readings were eliminated. The point formed by the convergence of the sheath leaves on top of the shoot was the indicator, and the readings were taken by sighting over the point to the meter stick. When the shoots outgrew the meter-stick we carried another with us and every time we wished to take a reading we set it upon the fixed one and proceeded as before.

The apparatus was set up and everything in readiness so that by October 25th the first readings were taken. An examination of table I from this point on will reveal our results. For the first five days readings were taken only every other day; then after that time, every day until November 22nd when measurements again on alternate days only were taken. On November readings were stopped. Inasmuch as the last three measurements showed no appreciable difference it was assumed that the culms had attained their full height.

Specific data on the moisture content of the air or on the temperature were not taken, but only general notes. Cold and warmth on the table are only relative terms and in themselves are not particularly interesting, but in relation to the growth-rate of bamboo culms they are especially useful and noteworthy. It is noticeable first of all that there is a general similarity in the three growth curves. When one is smooth, all are smooth. When there is a jog in one, all the others show jogs of the same kind at the same points. During the warm damp days from October 25th to October 31st growth continued smoothly and rapidly averaging 11.2 centimeters per day for the first four days and 13.7 for the next two. On November 1st it was clear and cold, and a wind sprang up, with the result that the average growth dropped to 11.3 centimeters and during the next two days only averaged 5. The cold broke again on the 4th, and a mild damp period of three days to the 7th followed. The curve now bends upward showing renewed briskness in growth, and the average daily growth jumps to 10.4 centimeters.

Already two weeks had elapsed and the culms had grown 136 centimeters. This added to their average height, 67.4, when measurements were begun, made their then mean height 203.4 centimeters, which was very near their full size. Every day, growth became less and less, as they approached their full heights. This is shown by the fact that their curves bend downwards more and more until they parallel the horizontal gradient, 200, on the table. It follows then as a corollary that irregularities due to changes in weather will also be proportionately less noticeable. By the 22nd measurements differed so little from day to day that it was thought useless to take them except on alternate days, and by the 30th they were stopped altogether.

In summing up: (1) the measurements of the three culms extended for a period of 37 days, at the end of which time it was thought that the culms had reached their full heights. It is reasonable to suppose, if we add five days as a maximum to allow for the time it took for the shoots to emerge from the ground, and grow to the height when measurements were begun, that only 42 days are needed for culms of square bamboo to attain their full heights; (2) the growth-curves of the three shoots show a distinct similarity in character; (3) the irregularities of one curve are of the same character and appear contemporaneously in other curves; (4) the inference is that the controlling influences are external, since those from internal and more deep-seated sources would manifest themselves periodically without regard for environment. To be more specific, irregularities in the curves may be observed only on cold days which cannot be said to occur with any degree of regularity. (5) From the evidence at hand we must conclude with Lock and Shibata that mild or warm moist days are more favorable to the smooth rapid growth of bamboo culms than cold and windy ones.

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TABLE I

Record of Daily Measurements of Three Culms of *Phyllostachys quadrangularis* *

1923		A	B	C
October	25th	81.6	56.9	63.9
,,	27 ,,	100.3	72.0	82.0
,,	29 ,,	128.2	96.5	112.0
,,	30 ,,	141.8	110.0	127.0
,,	31 ,,	154.4	123.0	141.4
November	1 ,,	163.3	134.4	154.2
,,	2 ,,	168.7	141.2	161.0
,,	3 ,,	172.0	145.0	165.8
,,	4 ,,	177.9	153.0	173.4
,,	5 ,,	185.8	163.0	183.5
,,	6 ,,	195.0	173.0	195.6
,,	7 ,,	203.0	186.5	205.2
,,	8 ,,	205.5	196.0	209.0
,,	9 ,,	207.0	194.5	212.0
,,	10 ,,	212.0	200.0	217.0
,,	11 ,,	213.0	205.6	221.0
,,	12 ,,	215.0	209.5	224.5
,,	13 ,,	216.8	212.8	227.5
,,	14 ,,	217.3	213.5	227.0
,,	15 ,,	219.0	216.2	228.3
,,	16 ,,	221.0	218.2	230.0
,,	17 ,,	220.0	221.0	232.5
,,	18 ,,	221.0	223.5	233.5
,,	19 ,,	222.3	225.4	234.0
,,	20 ,,	223.0	226.0	233.0
,,	21 ,,	223.3	226.2	232.7
,,	22 ,,	224.0	227.5	233.3
,,	24 ,,	225.3	229.0	235.5
,,	26 ,,	226.0	230.6	235.5
,,	28 ,,	227.0	231.0	236.0
,,	30 ,,	228.0	231.0	237.0

* In centimeters.

A NEW SPECIES OF NEPA FROM SOUTH CHINA. (HETEROPTERA, NEPIDAE)*

by

WILLIAM E. HOFFMANN

Nepa chinensis new species

During the fall of 1924 the writer took several specimens of an apparently undescribed species of water-scorpion of the genus Nepa. There are only two species in the genus Nepa as far as the writer's knowledge goes, *Nepa cinera* LINN. from Europe and *Nepa apiculata* Uhler from America. This species can be distinguished from *N. apiculata* and *N. cinera* by its smaller size and different shape. It is less broadly oval than these species, being between Nepa and Curicta in this respect. The respiratory tubes are long as in *N. cinera*.

Aside from these external differences the species is set off by marked antennal and genital characters. The penultimate antennal segment posseses a lateral prolongation longer than the ultimate segment, making the antennae not greatly unlike the antennae of certain species of Ranatra. The male genital capsule is similar to that of *N. cinera L.* in shape, but the proportions are markedly different as also are the claspers. In *N. cinera* L. the claspers are attached about midway between the two ends of the capsule, while this is not true in the new species.

As it is planned to rear this species a more detailed description of the adult will be left until the nymphal stages are described. What a study of its life history will reveal shall be of considerable interest inasmuch as the European *Nepa cinera* L. is said to have five nymphal stages while as the writer has already shown (Bul. Brooklyn Ent. Soc. Vol. XX, No. 2, p. 94) the American *Nepa apiculata* Uhler. has but four.

Field and laboratory observations to date show very little difference in habit between the Chinese form and the one from America. Last nymphal stages brought to the laboratory early in October soon transformed to adults and have been kept alive during the winter, by giving them an occasional feed of flies.

The water scorpions are not without historical interest as they are among the earliest aquatics to be recorded in the literature and as early as two hundred years ago both Ranatra and Nepa were figured. Although considerable recent literature has appeared concerning *N. cinera* L. no one seems to have carefully worked out its life history since the days of more thorough biological study. In the case of the American species, not only was the life history not known until 1923 but there also existed confusion as to its habits, especially of its egg-laying habits.

*Contribution from the Biological Laboratory.

SOME OBSERVATIONS ON THE BAMBOOS OF KWANGTUNG

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To place bamboos in their proper systematic relationship is a most puzzling task, due largely to the difficulty in obtaining flowering specimens. In my own efforts to distinguish the different bamboos found here, my attention has been drawn to the importance of vegetative characters. While some general notes on the culture and marketing of bamboos are included in this paper, its chief purpose is to describe a character by which bamboos may be divided into two distinct groups as regards their vegetative propagation.

The Two Types of Bamboos as Regards their Vegetation Propagation

To distinguish between these two groups I propose the use of the botanical terms *monopodial* and *sympodial.* (See Figs. 1, 2 and 4). Those bamboos belonging to the monopodial type spread by means of rhizomes whose tips (terminal buds) tend always to grow in a plane parallel to the surface of the ground, and at a uniform depth, probably determined by the nature of the particular variety of bamboo and the nature of the soil in which it happens to be growing. These rhizomes give rise to vertical stems or culms, by means of buds which occur singly at the nodes in an alternate arrangement. In a given growing season one or several of these dormant buds, on a given length of rhizome, may begin to grow. The number which spring from a given length of rhizome in any growing season probably depends upon the external factors of moisture, heat, fertility, etc., and the internal factors, including the supply of food furnished by the *"mother" plant* (竹母), as the nearest mature culm is called by the Chinese. Not all the buds give rise to upright stems, however. As a matter of fact, in some bamboos many of them never develop. Now and then one develops into a branch rhizome. This is known to occur when the growing tip is destroyed. Other stimuli, possibly related to the food balance, may also cause this branching.

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[*] Editors Note: During the past year Mr. McClure has devoted half of his time to the teaching of Botany at the Canton Christian College, and half to agricultural exploration for the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture. Prior to this he made trips to Hainan, Swatow, and northern Kwangtung. Mr. McClure's explorations have received wide recognition including a fellowship in the Royal Geographical Society. Some of the results of the his Hainan studies have been fully published in the pages of this Review and separates may be obtained by addressing us. Mr. McClure's numerous trips into the interior of Kwangtung have given him an unusual opportunity to make observations on the bamboos of this province. In a later issue of the Review, a list of the bamboos of Kwangtung with notes on their distinguishing characteristics will be published.

In the sympodial type of bamboo one or more of the dormant buds at the base of a mature culm develop, describing a curve and assuming an upright position very close to the mother plant. Each mature culm may give rise to five or six shoots annually. Since a short section of this type of stem is normally below the ground, horizontal in position, develops roots and has dormant buds, it comes under the category of rhizomes. But it differs radically in form from the rhizomes of the monopodial type descriped above, chiefly in that the new plant always develops from the terminal bud. Also, the rhizome part of the sympodial bamboo is larger in diameter than the culm which proceeds from it, while with the monopodial bamboo the reverse is the case.

The young shoot is a developing bud. While it is making its way upward through the soil, the enveloping sheaths form a sharp, horny point which protects the tender buds and enables them to penetrate the hardest clay. When the young shoot has reached the outer world, the tips of the enclosing sheaths, as they are pushed forth from the growing bud, begin to bear short leaf-like appendages which develop chlorophyll. The lateral buds of the short rhizomes of the sympodial type which are merely rounded bumps while dormant, are comparatively large in diameter with the blunt apex a little above the center. In this respect, they are quite different from those of the rhizomes of the monopodial type which are elongated and, while dormant, are flattened against the rhizome and extend toward its growing tip.

As the terminal bud or tip of the rhizome of the monopodial type moves forward by growth, the sheaths which protect it usually disintegrate fairly soon. The lateral buds are left, therefore, to the protection of their own horny budscales. In the sympodial type, however, the basal sheaths remain much longer and, together with a fine pubescence which often developes on the surface of the rhizome and on the scales of the dormant buds, they offer considerable protection to these buds.

So far as my observation goes, the rhizomes of both types develop one bud, and only one, at each node, and these are of course arranged alternately. Often, however, there are several nodes at the base of the culm which do not develop buds. Some bamboos normally develop branches from nodes quite low on the culm, while others normally do not develop branches on the lower nodes. Examples showing this difference are seen in figures 7 and 8. One and three are common numbers in which the side branches occur, but in the thin walled bamboos, known by the general name *Tan Chuk* (單竹), the lateral branches are many and slender, forming a tuft.

Clumps of the two types of bamboos may be readily distinguished by their habit of growth if allowed to develop undisturbed. Figs. 6 and 7. The canes of the monopodial type usually tend to stand very erect, while those of the sympodial type have a tendency to lean away from the center of the clump. This difference is due partly to the heavy burden of branches and leaves which the sympodial type often bears, and partly to the more open nature of the clumps of the monopodial type where a means is afforded for shoots to arise at a considerable distance from the parent plant. I have seen large clumps of the sympodial type in which the canes were so close together that the new ones were deformed by the pressure of the older ones. *Tai Lak Chuk* (大竻竹), seems to have a special tendency to this condition. Figure 7 shows a clump of this bamboo.

Uses of Bamboos

The uses to which bamboos are put are infinite. In an article to be published a little later it is proposed to indicate the general adaptations of the different bamboos found in Kwangtung. Some bamboos are grown primarily for their culms, others for their edible shoots, and still others for both. There seems to be little correlation between the edibility of the young shoots and the usefulness of the culms. Nor does either the monopodial type or the sympodial type have a monopoly on the useful parts in either of these respects, although of those studied, the monopodial type presents a larger percentage of edible kinds than does the sympodial type. The shoots of some kinds, however, must be parboiled and soaked before they can be made palatable. The culm is of course the most important part and it is indeed rare to find a bamboo whose culms are not good for something. The branches, leaves, sheaths, and even the rhizomes, find their own place in the economy of every day life. It is a common sight to see the fallen leaves in the bamboo gardens and on the village commons being raked up for fuel. The side branches of some kinds are bound into rough brooms and the rhizomes are used as fuel after they die. I have found only a few kinds which are not put to any use by the Chinese. In view of the almost universal usefulness of the members of this interesting group of plants, it is not surprising to find that by far the majority of them are more or less under cultivation.

Propagation and Culture

In the monopodial type new plants are started by means of a short section (four to eight inches) of a one-year-old rhizome. This is planted in January or February, being placed in the ground in a horizontal position at a depth of from three to six inches. Sometimes, in the case of the smaller bamboos of this type, an upright culm is allowed to remain attached. This, however, is not essential. A full grown culm detached from the rhizome from which it arose, may be transplanted independently, since it own root system, but with certain exceptions as in *Lei Chuk* (籬竹), it has will not reproduce itself. In this type branches of the culms are never used for propagation so far as my observation goes.

In the sympodial type proparation is effected by two methods. In the spring, preferably just before the beginning of the rainy season, a young plant of the preceding season, which has developed leaves and is beginning to develop roots is carefully severed from its parent plant at the point of union of the two and cut back to a length of three or four feet. Then the enclosing sheaths are removed from the base and it is planted. In certain species, however, notably the ones bearing large branches, the branches cut back to three or four feet in length, are planted as cuttings. In these bamboos, the branches are enlarged at the base, somewhat after the fashion of the young plants which have their origin at the base of the parent plant. Root tissue may develop at the nodes of these enlargements even while they remain attached to the parent plant. I have seen old specimens of this type from the base of whose large branches, roots one to two inches in length had developed, with no growing medium but the air. This readiness to form root tissue was doubtless the cue which started the Chinese farmers to using the branches of these bamboos to start new plants.

These two types are quite distinct in the kind of habitat which they seem to prefer. The monopodial type is grown almost without exception on hills or mountain sides. It is usually given little or no attention—never more than the digging up of the grass and weeds in the late summer. The sympodial type is invariably cultivated on level ground. In the case of those cultivated for their edible shoots, the young plants of the latter type are fertilized as soon as they are established. In March or earlier a mound of earth six to ten inches in height is raised around the base of the plant. The top of this mound is made level, a low rim of earth is constructed and liquid manure is applied. In the case of those grown for their culms only, usually no attention is given them until time for harvesting.

It is interesting to note, however, that in the culture of *Ts'ing P'i Chuk* (青皮竹) and *Cha Kon Chuk* (茶捍竹) in the Kwong Ning (廣寧) District the culms are often branded, that is, a mark or symbol is scraped on each culm at a height just below the level of the eye. Some samples of these symbols are given in figure 3. Their purpose is three fold, First, they assert the ownership of the one to whom the bamboos belong, preventing stealing, at least on a large scale. Secondly, they are a sign to the workers who are hired to cut the bamboos, enabling them to distinguish the property of two owners which sometimes becomes more or less intermingled on the boundary lines. Thirdly, they afford a convenient means of checking off culms in estimating the harvest. This branding is done when the culms are about one year old.

Development and Size of Shoots

Generally speaking the monopodial type develops its shoots one to two months earlier than the sympodial type. *Mau Chuk* (茅竹) produces the first shoots of the season. These shoots appear on the market in limited quantities, in January or even earlier and are known as *Tung Sun* (冬筍) or "winter shoots''. They have undisputed monopoly of the market at a high price until early in March when a number of kinds begin to make their appearance. The season for this type is soon over, and then it is about a month before the shoots of the sympodial type begin to appear.

For the most part the shoots of the monopodial type are small and slender, usually one inch or less, in diameter, and four to eight inches in length. *Mau Chuk* (茅竹), however, is a remarkable exception, its shoots aften reaching a diameter of four inches or more. I have seen on the market in Tsing Un (清遠) a sprout of this bamboo two and one half feet in length. A merchant there told me that he sold one last year which weighed sixteen catties (over twenty pounds). See Fig. 9.

On the other hand, the shoots of the sympodial type are usually quite thick. They average three or four inches in diameter, but specimens over one foot in length are rarely seen on the market.

Harvesting and Marketing of Shoots

When the young shoots first appear above the ground they are at their best, but they are allowed to attain a length of six to eight inches in most cases, and as much as two and one half feet in the case of *Mau Chuk* (茅竹). This is done at the expense of quality, however, in order to increase the quantity of edible material.

The shoots are severed from the parent plant by means of a sharp, spud-like instrument after the earth has been removed to reveal the point of union. In the monopodial type the shoot is cut off as near as possible to the rhizome without injuring the latter. In the case of the sympodial type, however, care is exercised to preserve the horizontal portion or rhizome. If this is done a new plant may develop the following year from the stump. See Fig. 1 I have noted one instance in a plant of *Tai T'au Chuk* (大頭竹) at the Canton Christian College, in which the parent plant is now beginning its fourth year of growth and in each of the three since it reached its maturity it has produced a new plant in this manner. If this precaution is not observed, and the shoot is severed at a point near the parent plant, it is necessary each year to raise the mound sufficiently to cover the next higher node. Under this stimulus, this node will develop roots and a bud which will become a shoot the following year.

Bamboo shoots are marketed as promptly as possible after being harvested. The sheaths are generally left on in order to protect the tender edible tissue from excessive evaportion. In certain instances, notably *Wong Kom Chuk* (黃甘竹) and *Fu Chuk* (苦 竹), in which the shoots must be parboiled and soaked, the sheaths are removed and the shoots put through this process in preparation for the market. In this case, the husked and parboiled shoots are displayed on the streets in tubs of water. See Fig. 9. The buyer invariably splits them from end to end to drain out the water with which the inner nodal cells have become filled, before he permits them to be weighed.

In being brought in from the villages over the comparatively short distance to the local markets, the shoots are carried loosely in open baskets. Here they are sorted and the surplus supply packed more carefully into cheap bamboo baskets of about a bushel capacity, a piece of sedge is matting is sewn over the top and the whole shipped to the larger market, Canton, for instance, by train or river boat. The price varies from five to sixty cents silver, per catty (one and one-third pounds), depending upon the variety of shoot, season, and the locality.

Harvesting and Market the Culms

Culms for commercial purposes are usually at the age of three years. This is true of all the kinds of which I have any information on this point. The appearance of the culms, however, is the cue which is followed in the harvesting. At the age of three years the green color has paled perceptibly, and, in the case of *Tsing P'ei Chuk* (青皮竹), has begun to give way to a yellow tint. In many cases pale green lichens have begun to form colonies on the culms by the time they have reached this age. As to the season for harvesting, care is taken that culms be cut at no time when immature shoots may still be considered to be dependent upon them. In the case of monopodial rhizomes, the harvest begins approximately in the sixth Chinese month (July) and may continue until November or December. In the case of the sympodial type, harvesting begins later.

In most wholesale dealing, the culms are sold by the hundred catties. This is particularly true of *Mau Chuk* (茅 竹), *Man Chuk* (文 竹), *Ts'ing P'i Chuk* (青皮竹), *Ch'ang Ko Chuk* (撐篙竹), *Kan Chuk* (根 竹) and *Wong Kam Chuk* (黃甘竹). In *Fat T'o Chuk* (佛肚竹) and *Kan Chuk* (根 竹), they are sold by the bundle of one hundred pieces. In retail dealing, however, the culms are sold by the piece. *Cha Kon Chuk* (茶桿竹) is an exception, being sold wholesale by the piece in case of large culms, and by the bundle of standard circumference in the case of the small culms. Usually the first wholesale price includes delivery to the bank of the nearest stream sufficiently large to float the culms. A large part of the annual crop of this bamboo finds its way into the export trade and is sent to America, England, and Europe for the manufacture of fishing rods, etc.

The culms must of course be carried on the backs of men from the groves, to the arteries of transportation, the rivers, which play a most important part in marketing. *Mau Chuk* (茅 竹) is now quite commonly shipped to Canton from the North River region by open freight cars. This more expensive means of transportation is probably justified on the basis of the comparatively great commercial value of *Mau Chuk* (茅 竹).

Cha Kon Chuk (茶桿竹) is put through a special process in its preparation for the market. The culms are taken to a point on the stream where a supply of clean, fine sand is available. Here the canes are all thoroughly scoured and washed to make them clean and smooth. They are then dried and cured in the sun, usually about a week in good weather. They are then sorted, cut into the desired lengths, bound into bundles of standard size and stowed into large native freight boats for shipment to Canton or Fat Shan. This bamboo is never floated to market because the water would stain it and thereby decrease its market value. Most of the crop of this bamboo, is, so far as I know, grown only in a limited area near the boundary between Kwangtung (廣 東) and Kwangsai (廣 西) provinces in the two districts of Kwong Ning (廣 寧) and Wai Tsaap (懷 集).

Bamboo Rafts

In the case of *Ch'ang Ko Chuk* (撐篙竹), *Mau Chuk* (茅 竹), and *Ts'ing P'i Chuk* (青皮竹) the most common means of getting them to the market is by rafts on the North, West, and East Rivers. These rafts are of three types. The most common type is made by tying the bamboos in bundles about a foot in diameter with butts all facing one way, and placing these bundles in series so that the butt ends all face forward, each rank of bundles overlapping the rank in front one half to two-thirds of its full length. This type of raft may be six to twelve meters wide and thirty to sixty meters in length. The unit bundles are tied together with thongs made of *Ts'ing P'i Chuk* (青皮竹). A second type of raft is made by means of laying side by side in parallel rows, without overlapping, bundles of uniform length which are then tied together by means of thongs and rope made of *Ts'ing P'i Chuk* (青皮竹). Rafts of a third type are made in a single unit in the form of an enormous cigar. These may be two meters in diameter and ten or twelve meters in length. The current of the stream furnishes the chief mean of propulsion for the first two types of raft. However, provision is always made so that oars may be used in guiding and propelling. Expert poling is a most essential feat in the proper handling of these awkward craft. A slow but effective means of guiding them and preventing disastrous collisions is afforded by a large, iron-tipped, wooden anchor which is attached to the rear of the raft by a bamboo rope, ten to fifteen meters in length and floated on a smaller raft when not in use. This small raft is maneuvered by one man whose only means of propulsion is a stiff bamboo pole, invariably of the variety *Ch'ang Ko Chuk* (撐篙竹). Swinging to the right or left of the course of the large raft he dumps the anchor into the water and it does the work by holding steady until the current of the stream brings the long and unwieldy creature into line. The cigar shaped rafts are always lashed on either side of a freight boat which sails, is rowed, or towed down the river.

Summary

All bamboos which have been observed by the writer fall into one or the other of two distinct groups as regards their rhizomes. The terms monopodial and sympodial are proposed as describing these two groups. The rhizomes of the monopodial type are indeterminate in their growth, and more slender than the culms to which they give rise. The rhizomes of the sympodial type are determinate in their growth, and larger in diameter than the culms to which they give rise. The two types seem to differ radically in their preference as to habitat, the monopodial bamboos being grown in the mountains and the sympodial bamboos being grown in the level places almost without exception. In the propagation of the monopodial type the rhizomes are indispensible. The bamboos of the sympodial type are mostly propagated by means of material in which the rhizome is essential, but branches may be rooted in some cases. In both of these two groups are found useful bamboos with respect to culms or edible shoots or both. The shoots of the monopodial type develop a month or so earlier than those of the sympodial type. The culms of both types are harvested only while no immature shoots are dependent upon them.

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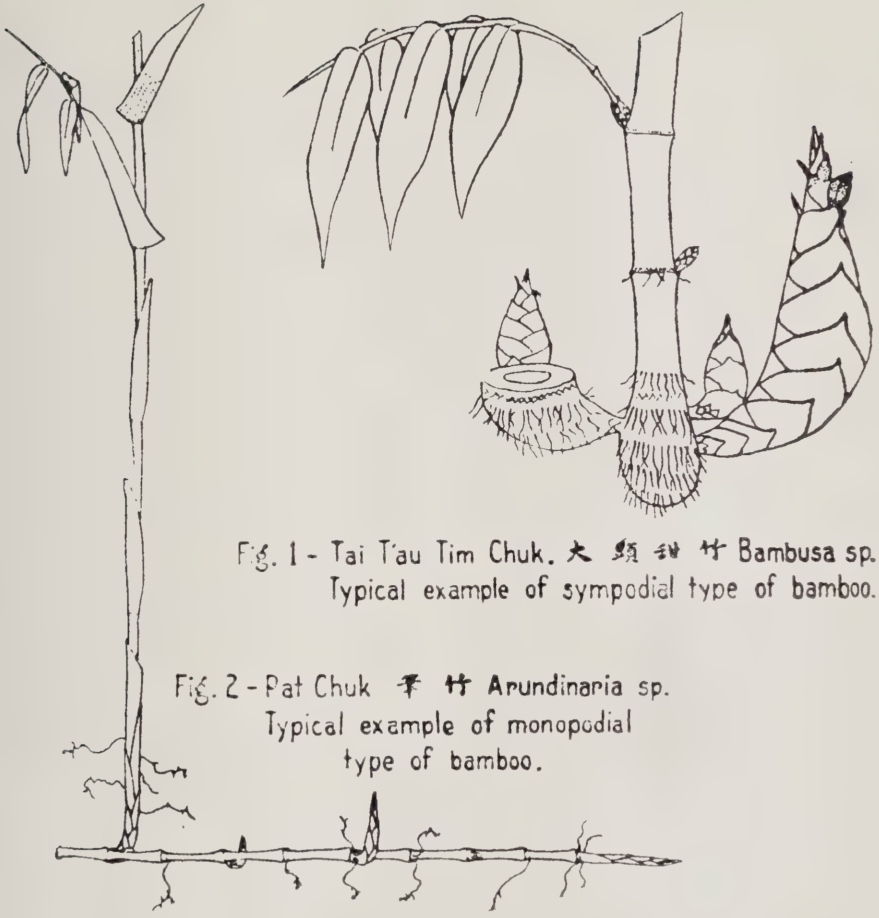

Fig. 1 - Tai T'au Tim Chuk. 大 頭 甜 竹 Bambusa sp.
Typical example of sympodial type of bamboo.

Fig. 2 - Pat Chuk 筆 竹 Arundinaria sp.
Typical example of monopodial
type of bamboo.

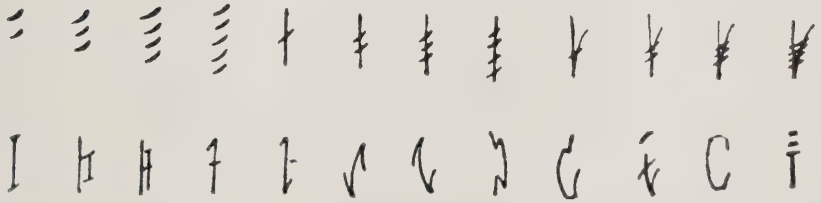

Fig. 3.- Symbols used in "branding" the culms.

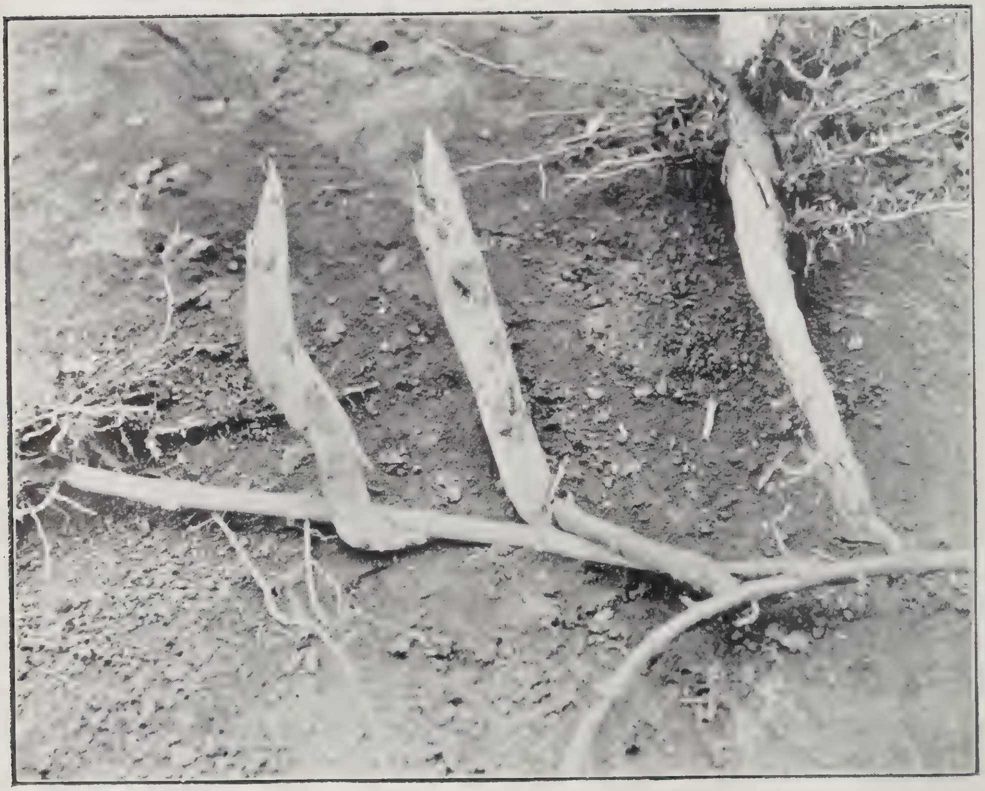

Fig. 4 - P'o Chuk (蒲 竹) member or the monopodial group, showing rhizome, young shoots, and base of mature plant with root system.

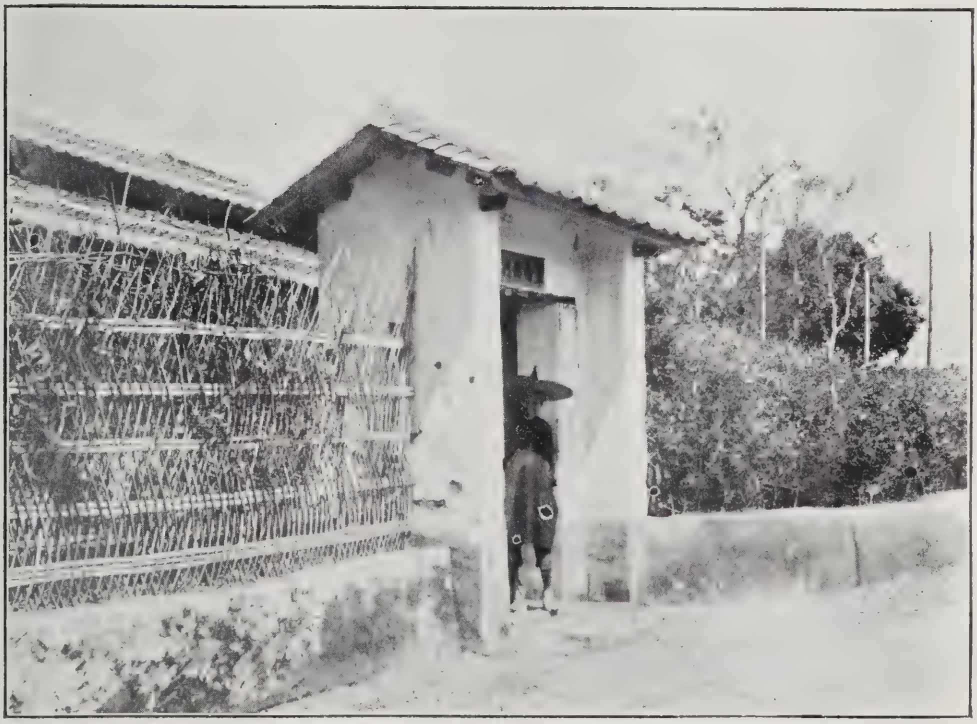

Fig. 5 - Gateway to dwelling at T'ai P'ing Shi, Ts'ing Un (太平市, 清遠) showing fence woven from culms of Wong Kom Chuk (黃甘竹) on left, and hedge of Kai Pi Lak Chuk (雞皮筋竹) on right.

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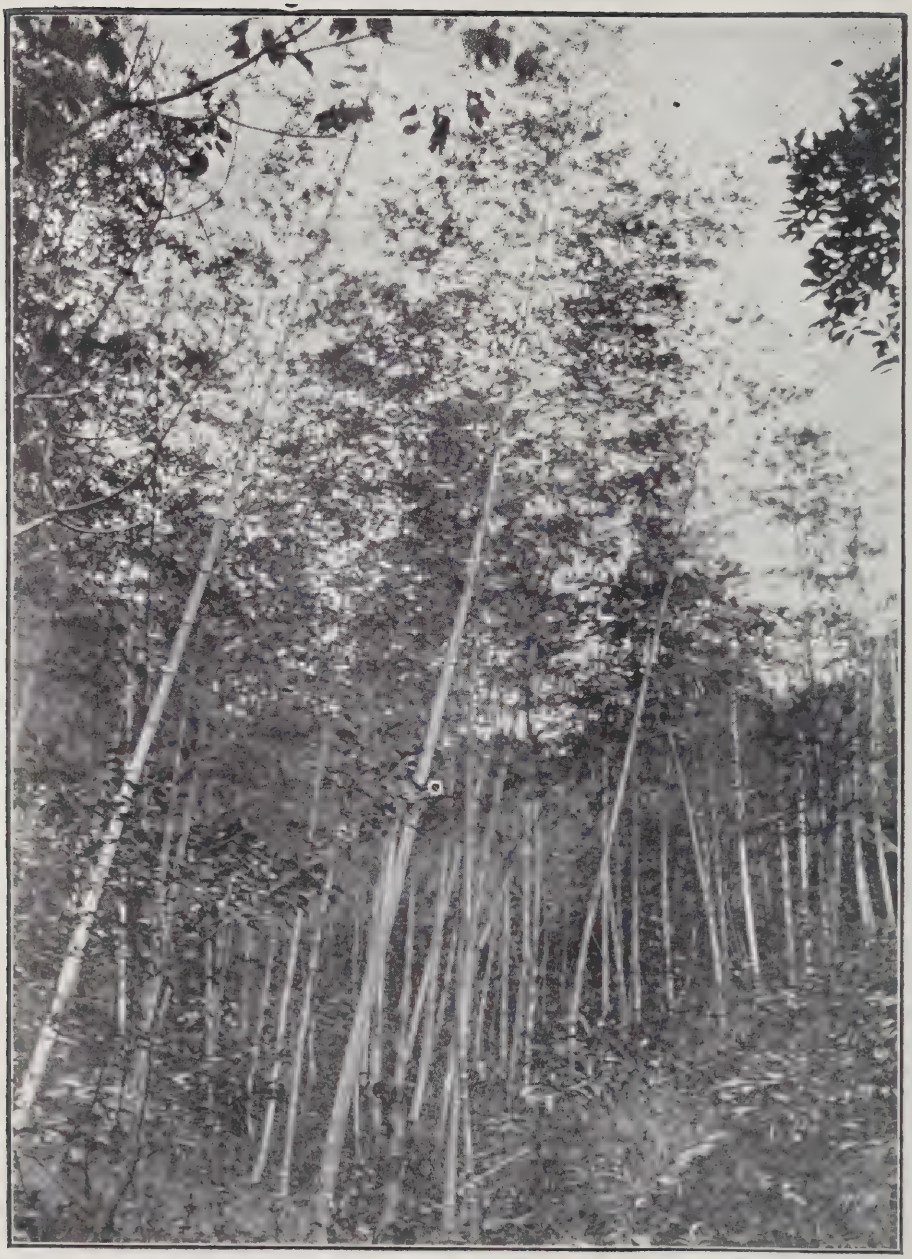

Fig. 6 - Mau Chuk (茅竹) *Phyllostachys sp.*, member of the monopodial group, showing open nature of typical clump.

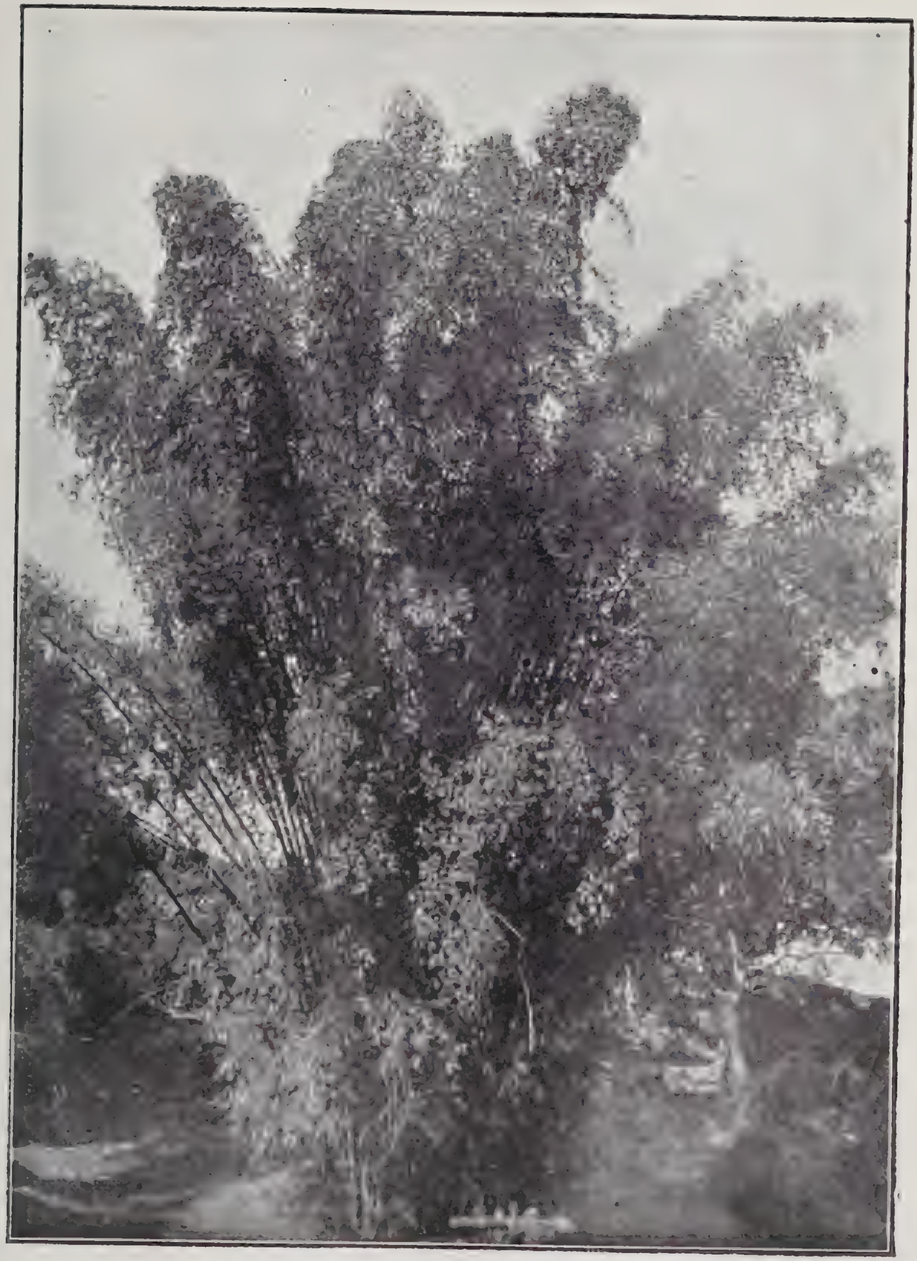

Fig. 7 - Lak Chuk (簕 竹) *Bambusa sp.*, member of the sympodial group, showing dense, crowded nature of typical, undisturbed, clump.

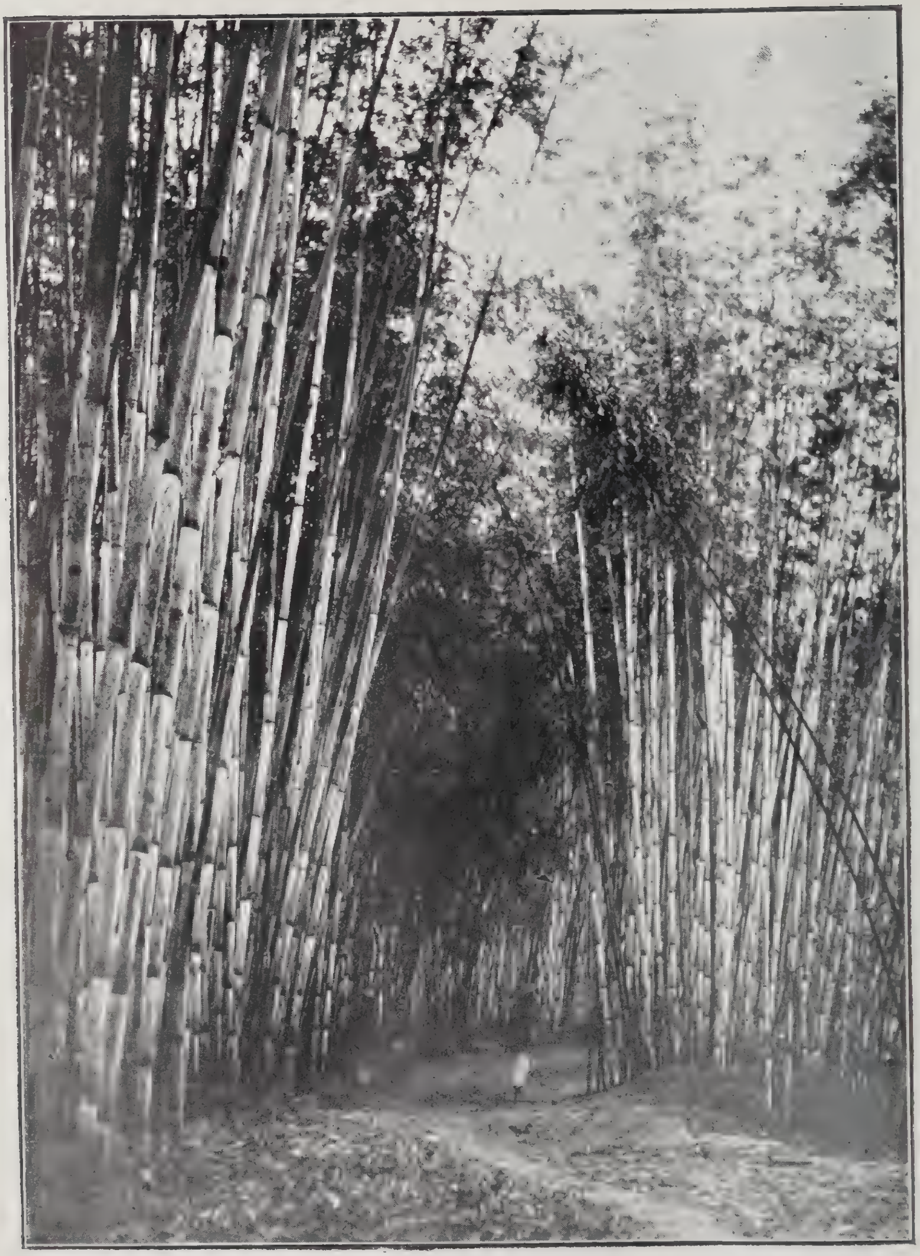

Fig. 8 - Fan Tan Chuk ([illegible]) *Schizostachyum sp.*, a member of the sympodial group.

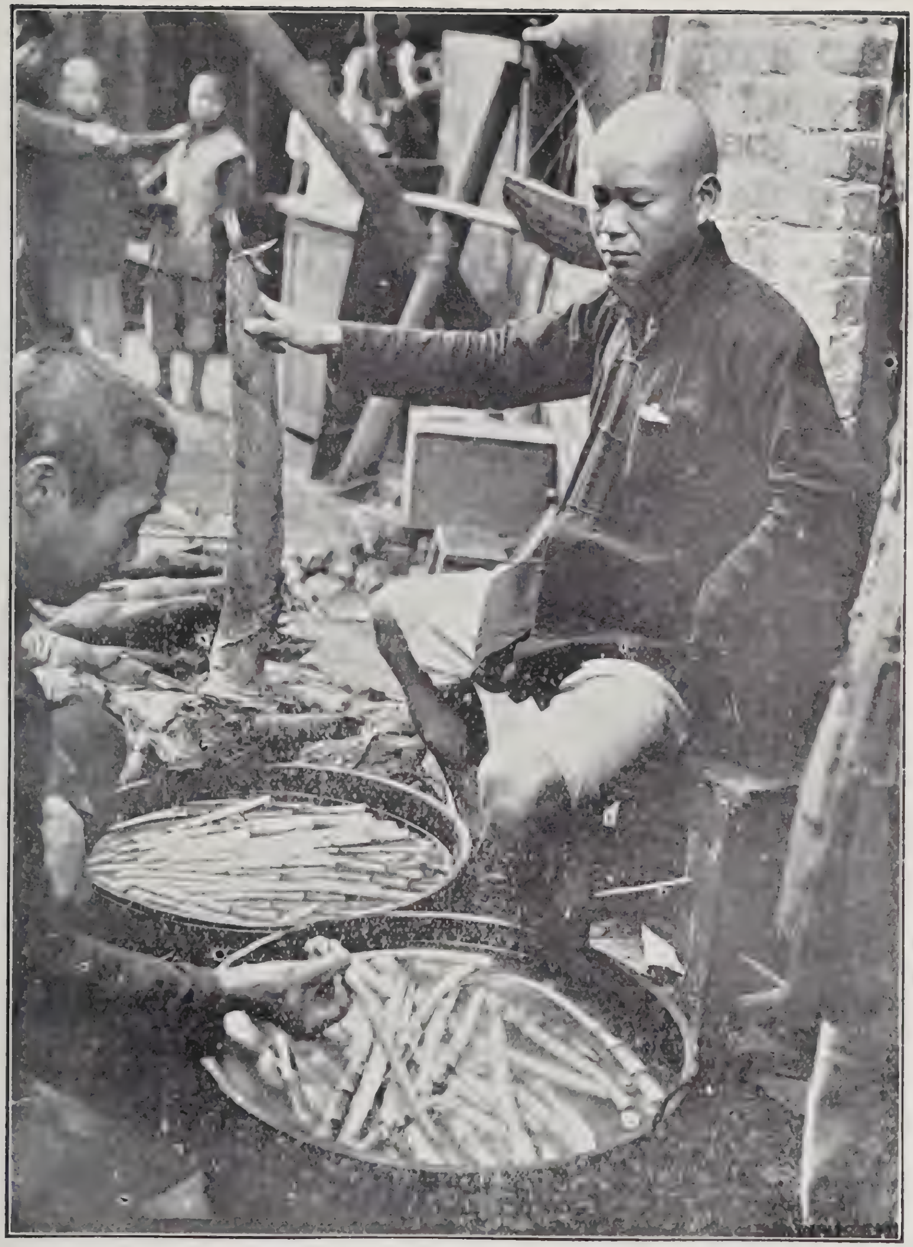

Fig. 9 - Street market in Ts'ing Un (淸 遠) displaying Wong Kom Chuk Sun (竹 筍) in tubs, and Mau Chuk Sun (茅竹筍).

THE BIOLOGY OF A COMMON CHINESE WATERSTRIDER (HETEROPTERA, GERRIDAE)*

By

WILLIAM E. HOFFMANN

Introductory statement. This is the first of a series of papers dealing with the biology, ecology, and taxonomy of the aquatic insects of South China. These studies have been undertaken primarily in connection with some investigations of the freshwater fisheries of this region. It is a well-known fact that the science of aquiculture for the most part, is in the same undeveloped condition that agriculture was many decades ago. In some of the instances where we have had great improvement in the science of water culture the development has been for the purposes of sport and not because of a greater demand for food production. However, as time goes on, due to increased population, decreased (proportionately) number of people in food production work, and other factors, the demand on our water areas for food production is becoming greater and greater. To meet this demand for increased production we must make careful studies of our water environments and place the operation of them upon a more scientific basis. A part of these studies will of necessity include an investigation of the interrelations of our aquatic fauna and flora.

The Heteroptera were selected for the first investigations because this group contains the forms most injurious to fish culture and also because it is a group with which the writer is acquainted taxonomically. At the present time there is little literature and no comparative material available to the writer, but before long it is expected that such will be available and that the identity of forms studied may be known.

The form constituting the subject of this paper cannot be identified with the meagre literature at hand. It is no doubt a widely-distributed and perhaps well-known species, for the writer has collected it in several places in Japan, in Hongkong, and various places in Kwangtung Province. In fact field observations to date indicate it as the most common strider in this locality. This strider has habits and also habitus, to some extent, of *Gerries (Limnoporous) rufoscutellatus* Latreille, which is said to be the most cosmopolitan of all waterstriders, and is recorded from Northern Asia. In fact the first nymphal stage of the Chinese species looks very much like that of *G. rufoscutellatus* L., but the later stages and the adults are quite distinct from that species. The adult as well as the nymphal stages will be described so that not only may the form be recognized in all stages, but also the species name may be determined by those who have access to the necessary literature.

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* Contribution from the Biological Laboratory.

Habitat. The present species has been taken on slowly-moving and on quiet waters, both in Japan and China. In Hongkong it was taken in a water reservoir well up the "Peak" or mountain side. The still waters on which it has been taken range from the small stagnant pools and ditches to the large fish ponds commonly found along the river banks. In the ponds they are found most abundantly near the shore, often on emergent or floating vegetation, ever on the alert and ready to dart away from the bank. While they readily make use of vegetation or other supports they seem to be quite independent of it as evidenced by their living in water reservoirs utterly devoid of vegetation or support of any kind. This bug likes a bit of open water always to be near it in order that at the first sign of danger a vigorous push with the long powerful hind legs will put it in the clear. They avoid dense masses of plant growth. If numbers constitute a good index they perfer ponds of a diameter of forty to fifty feet, partially protected by banks and plant grown, containing a moderate amount of water plants, and not too stagnant.

Hibernation. Little opportunity was afforded for field work at a time when observations might have been made as to hibernation. These few observations seemed to indicate that this species hibernates for a time during the colder part of the year. At this time of the year the ponds are very low and the Gerrids present should for that reason be easily seen. If they do not actually hibernate, they at least are inactive and remain well out of sight. During the latter part of February and the early part of March the overwintering adults are everywhere in evidence and are very active indeed.

Mating. The mating is not unlike that described for other striders. The female seems not to be inconvenienced by the presence of the male upon her back for she swims, feeds, cleans, and carries on all activities much as though she were unaccompanied. Mating takes place, both in the field and in the laboratory, at any hour of the day or night and some mating bugs have been observed to remain in copula for over two hours at a time. A given pair will mate several times per day, everyday, for a period of at least a week, the longest time any particular pair was kept under observation.

Preoviposition. But little data were secured relative to the length of the preoviposition period. Female No. 5-16 which molted to an adult on April 19, died on May 3rd and when dissected was found to contain 42 well-developed eggs This specimen was reared in a glass jar three fourths inch in depth and two and three fourths inches in diameter, in which there was no vegetation furnished for egg laying. The shallowness of the container prevented her from depositing her eggs upon the side of the glass and consequently her death was caused by her inability to lay eggs. In this case, then, the period before oviposition was fourteen days but the period might have been several days shorter had the proper medium for egg-laying been provided.

Oviposition may have been further delayed for the reason that the female was not provided with a male until three days after she reached the adult state. In the case of some species of Microvelia unfertilized females have a longer preoviposition period than do fertile ones and they also lay fewer eggs.

Oviposition. Eggs have been found in the field, attached to stems, both dead and alive, to sticks, to rocks and to grass blades. In the laboratory, if nothing is provided for oviposition this strider will oviposit on the side of the glass container. The eggs when deposited on a floating grass blade or stick are placed on the under side. They are placed end for end lengthwise of the object upon which the eggs are laid. They may be close together or a millimeter or more apart, and are deposited in a bit of gelatin-like material. The eggs are normally placed paralled to the surface of the water. Less information was gathered on the number of eggs laid at one time than was desired but it was ascertained that a female may lay at least as many as a dozen eggs in a few hours time. In the laboratory the eggs were always deposited at night. The actual deposition of eggs was never observed although often watched for. The female probably maintains herself upon the surface of the water quite independent of the object to which the eggs are attached, for she could scarcely gain support from a delicate blade of grass.

Fecundity. Data concerning fecundity were not obtained. Adult females brought in from nature deposited several dozen eggs each during a period of two or three weeks and the liklihood is that some, at least, of them had laid eggs before being collected. One reared specimen dissected two weeks after emergence as an adult contained forty two eggs that were well advanced. She probably would have laid several times this number during her normal existence. A specimen of *Gerris* (*Limnoporous*) *rufoscutellatus* L. kept in the laboratory several years ago by the writer, deposited 110 eggs during thirty days, and average of three and two-thirds eggs per day.

Incubation. Eggs deposited during the night of May 31st hatched the evening and night of June 7th, making an incubation period of seven days. Of course temperature is the big factor determining incubation. Some eggs laid about a month earlier had a much longer incubation period. The amount of water covering the eggs seems to affect the incubation. Normally the eggs are deposited just beneath the surface film of the water, but, in some cases in the laboratory the sticks or stems containing the eggs sank to the bottom, and in such cases the eggs hatched a day or two later than the rest.

Hatching. The hatching is similar to that of other Gerrids and takes place in a very short time. The egg for some time before hatching gets quite dark and through the shell may be discerned the eyes, egg burster, antennae and legs. The embryo bug is usually lying ventral side up but occasionally one is found which is midway between this position and lying on its side. Upon hatching the egg splits for about two thirds its length, the split starting at the blunt (anterior) end. The split is along the ventral median line of the unhatched bug. The egg burster is the first part to move out through the newly made aperature, and is followed at once by the base of the beak and the eyes. As the emerging nymph comes outward it also extends upward, and when it has pulled itself pretty well out of the egg the embryonal skin seems to get caught and the insect undergoes the post-natal molt. This early nymphal skin is very thin and transparent excepting the black conspicuous egg burster, and remains hanging to the egg after hatching is completed.

The unfolding, so to speak, of the nymph as hatching proceeds, is particularly interesting. The legs of the unborn nymph are closely pressed to its ventral side, folded around the tip of the abdomen and up the back side of the embryo, and it seems as though the new arrival will never be able to pull its legs out of the egg for their full length. As one observes the hatching he cannot help but feel as though the nymph has legs too long for proper control.

Behavior of newly hatched. Any doubt the observer has as to the usefulness of the long legs of the emerging nymph are quickly dispersed as soon as hatching is completed. Hatching of eggs that have been normally placed enable the nymph to gain the surface of the water as it hatches, in fact it would be impossible for it to hatch without gaining the surface. In the case of those eggs which sink into deep water, the nymphs upon hatching have a very serious time, and most of them do not gain and maintain the surface. Such nymphs may remain submerged for hours, frantically swimming about, but seldom if ever, gaining access to the surface of the water. If they are lifted out of the water and placed upon vegetation they immediately plunge into the water again. If such waterlogged nymphs be placed for an instant on clean dry blotting paper and then removed for an hour or so to a life history jar containing only damp sand, they may be saved. The nymphs that gain the surface of the water as they should upon hatching no sooner kick and pull themselves free from the egg and nymphal skin than they commence the cleansing process. They pull the antennae, first both at once, later one at a time, through the front legs. The legs are placed so as to have the tibiae adjacent and it is between them that the antennae are pulled. The rostrum is then cleaned and findly the body and legs. The body is cleaned by brushing with the legs, sometimes one leg only is used, sometimes more. The legs are cleaned by rubbing them together; the legs and the body are cleaned alternately. Throughout this clean-up process the young nymph remains quite stationary, and in the meantime the body fills out considerably and the characteristic first-instar color-markings appear. This entire performance does not take long and after it is completed the bug becomes quite active and is also ready for its first meal.

Number of Instars. There are five nymphal instars and in the table below is given the duration of each.

Molting. The molting was quickly accomplished and seemed not to be a hard task, but the mortality at molting time in this species as in many others, signified that this is a critical time in the life of an insect. Several hours before molting time the nymphs lost interest in food and shortly before molting they became darker, somewhat bloated in appearance, and more or less sluggish. The skin split along the median dorsal line of the thorax and in a y-shape on the head. Sometimes the nymphs died before the split occurred, sometimes when it had just started and in still other cases after considerable of the thorax had pushed through the split. In several cases the molting was completed excepting for one leg which the nymph was unable to free from the molted skin. If one is present at the time of molting and aids the bug in freeing itself no harm results. If this help be not given until sometime after molting the leg will be deformed until after the next molt. After molting is finished the cast skin floats on the water like a raft. The new bug, which is very pale, busies itself cleaning and soon colors up. It then moves about and by the time it has its full coloring it is ready to partake of food.

Maturity. Sexual maturity is soon attained. Only a few pairs of newly emerged adults were kept in the laboratory and time permitted only casual observation of these. One pair was observed to copulate on the ninth day but it is probable that they had mated before this but were unobserved. Females deposit eggs within two weeks after becoming adults.

Longevity. Two months was the longest period that any specimen of this species was kept in captivity, but the specimens kept for longevity record were those that had spent the winter as adults. Adults appearing in the spring of the year are still alive when the earliest nymphs reach maturity, at which time field observations on longevity must come to an end. Unless the overwintering adults are always those which reached maturity very late the preceding fall, which seems improbable, they would be about a year old by the time the first nymphs reach maturity. It would be interesting to know if adults of late summer which lay eggs the same season, live during the winter and lay eggs again the next spring and summer. There is not a great deal known about the longevity of aquatic Hemiptera and references regarding this point usually say or imply that some, at least of them, probably live a year or more. The writer was able to keep specimens of the American *Velia watsoni* Drake alive over eighteen months, during which they had two distinct periods of egg production, extending over several months each, during succeeding summers. Some of the aquatics seem to have a marked periodicity in the production of eggs while others, such as certain species of Microvelia apparently produce eggs from the time of maturity to death unless interrupted by a period of low temperature.

Number of Generations. As shown above maturity was reached very eary early, and later in the season when the temperature is higher it doubtless would be reached in still less time. This coupled with a short nymphal life, would enable the species, provided there is no periodicity involved, to go throught several generations annually. The time required for nymphal development is surely much shortened as the season advances. *Gerris* (*Limnoporous*) *rufoscutellatus* L. as shown by the writer (Annals Ent. Soc. Amer. Vol. XVII, pp. 427-430) completes its development in nineteen days (average) during the warmest part of the summer. Nymphs of this common Chinese Gerrid have been observed in this locality from March 9th until late in the fall.

Food Habits. The bugs were reared in the laboratory exclusively on house flies. In nature their food apparently consists of any animal matter they can secure. While they prefer to capture and kill their own food they do not disdain to eat dead insects. They seem to feed on all aquatic or terrestrial insects or spiders that they are able, individually or collectively, to capture. They do not pay much attention to under surface forms, even when such come to the surface, but feed extensively upon emerging insects, such as mosquitoes, midges, mayflies, damsel flies, and aquatic Diptera. Of the terrestrials I have seen them feeding upon grasshoppers, leaf hoppers, tree hoppers, ants, beetles, flies, small Hymenops, caterpillars and occasionally grouse locusts. When an insect or spider too large for one strider falls into the water, a number of striders will cooperate in the overpowering of the unfortunate individual. When smaller insects fall into the water there is anything but cooperation, in fact there is very keen competition. The bugs realize the source of their terrestrial insect food, for they frequent the parts of ponds where there is much overhanging vegetation.

Behavior. Little attention was paid to their behavior under laboratory conditions for they were kept in such small containers that their actions were probably not normal. Early in the morning, in the evening and on cool cloudy days they are most active and can be observed with little effort on the part of the observer. If a position be taken up near a group of them and if the observer remains quite he will soon be rewarded by lots of activity very close at hand. While these bugs seem never to miss an opportunity to feed it is during the mornings and evenings (and on cloudy days) that they seem to be actively in search of food. During hot or windy weather they remain close to the shore or in a shady place protected from the sun. In the larger ponds they do not go far from the banks. They are difficult to capture, much more so than the graceful *G. rufoscutellatus* L. for in addition to the long jumps of that species, they are exceedingly adept at dodging. When hard pressed they are just as likely to dart toward the shore and the collector as away. At times, also, they partly fly and partly jump several inches into the air. The species is somewhat gregarious.

Enemies. As far as the writer's observations go this form does not have any serious enemies. The eggs, of course, are subject to the extremes of weather and doubtless many are rendered infertile by changes in the water level during storms. A species of catfish as well as a very predaceous scale fish have been observed to catch nymphs but the number caught is probably small. At hatching and molting (in case of the first and second instars) times the nymphs are subject to attack by their own kind and by other insects. The writer has seen both Hydrometra and Mesovelia capture and kill first instar waterstriders.

Description of Stages.

Egg. Length 1.362 to 1.566 mm.; greatest width (at blunt end) .454 to .499 mm., elongate cylindrical, broadly rounded at one end, slightly tapered at the other. Yellowish-white when first deposited but becoming cream-colored shortly afterward. The eggs are fastened to their supports by means of a mass of translucent mucilaginous material which is waterproof. The cream color becomes somewhat reddish about the time the eyespots appear. Upon hatching the eggs split from the broad end to a point one-half to two-thirds their length. After hatching the empty egg-capsule is translucent and to it is attached the embryonic skin which is also translucent and very thin. On it may be seen the black egg burster.

First Instar. Nymph several days old measured dorsally as follows: length along median line 2.156 mm.; width of head across eyes .567 mm.; length of prothorax .249 mm.; greatest width of mesothorax (widest part of entire bug) .885 mm.; length of intermediate tibia 1.362 mm.; length of antennal segments, one to four respectively, .181 to .227 mm. (curved and difficult to measure); about .158 mm.; .181 mm.; and .454 mm.

Body pale with head (including antennae) and legs brown. Two large brown spots on prothorax, one on either side of dorsi-meson, covering perhaps one half of the prothorax. The spots are .249 mm. long and nearly as wide. Two irregular brown spots at the intersection of the fused meso-and metathorax. These spots are .408 mm. long and .227 mm. wide, irregular in outline and slightly larger anteriorly, and also have a small projection anteriorly. There is one of these spots on either side of the dorsi-meson and the portions on the meso-and metathoracic segments are subequal. There is a pale space of .227 mm. width between the spots. A transverse darker line about the middle of the spots indicates the line of fusion between the last two thoracic divisions. The pale portion of the bug is stippled with short closely-set hairs. There are two transverse brown lines on each abdominal segment, one on either side of dorsi-meson, near the anterior margin of the segments. On the last three segments these lines approach spots in appearance as they are about as long as wide. Genital segments brown above. A brown transverse line on either side of thorax indicates join-ing of pro-and mesothorax. Pale median line on head branches near posterior margin of head, the branches extending outward in front of the eyes. Legs and antennae also well covered with hair, hair both longer and more closely-set than on body. Trochanters of intermediate and posterior legs, as well as their intersections with coxae and femora, and anterior femora, partly pale. Second and third antennal segments about subequal, the second heavier; basal one fourth of third segment pale. Diameter of antennae about .068 mm. Ventrally.——Body whitish with beak and genital segments brown, the last segment of the former black. The beak reaches beyond the prothorax. Ventral side of abdomen with extremely short hair. The first-instar markings of this species are much the same as those for *G. rufoscutellatus* Latr., but the head and legs are a darker brown, there are some brown markings on the outside of the coxae, and the fourth antennal segment is shorter.

Second Instar. Nymph less than twenty-four hours old measured dorsally as follows: length along median line 2.882 mm.; width head across eyes .749 mm.; length of prothorax .272 mm.; greatest width of mesothorax .908 mm.; length of intermediate tibia 1.952 mm.; length of antennal segments, one to four respectively, .363 mm. or more, and curved; .204 mm. (still slightly heavier than 3rd segment but less noticeable than in 1st instar); .249 mm.; .612 mm.

General color brown, with certain portions paler, others darker brown.

Head.—Largely pale. Between the eyes and extending slightly beyond their anterior margin, a somewhat rectangular brown spot .181 mm. long and .068 mm. to .158 mm. wide, being widest at its anterior margin. From this spot forward a brown median line. Forward of this spot and equidistant between median line and lateral margins of head there is a brown spot on either side of head. There is also some irregular brownish blotching at the posterior margin of the head.

Prothorax.—Brown spots larger, more irregular in outline, covering most of the prothorax. Pale median portion now has a faint but distinct brownish median line. Mesothorax.——With a combination of dark brown, light brown and pale which would require a long description to accurately describe. On the caudal half on either side of the middle of body, a darker patch irregular of outline, but about .363 mm. long and of greater width anteriorly than posteriorly. In a second-instar nymph five days old the darker patches on the mesothorax are longer and wider and extend onto the metathorax. Anteriorly, on either side, slightly nearer middle of body than lateral margins of prothorax, the mesothorax has a line extending backward, bulging outward near its middle and again inward as the posterior margin of the mesothorax, which it forms, is reached. From the place where the bulge commences to recede the line apparently changes from one of color to one of structure, for the place where the meso-and metathorax fuse is quite distinct in this instar. Metathorax.——Other than being definitely outlined has no distinctive marks. Abdomen.——Segments have transverse lines near their anterior margins just as in the first instar, but less distinct. On the laterodorsal margins of the abdominal segments there are pale spots. The genital segments show more plainly in this instar. The posterior margins of last abdominal segment and first genital segment quite heavy and distinct. Inner margins of intermediate and posterior femora and tibiae bear spines. Ventrally.——No great change from the first instar, last genital segment is slightly darker. The round capsule portion of the genitalia can be seen to possess a pale median line. In this instar a dark median body line appears. In this instar of *G. rufoscutellatus* Latr. there is a pale median body line, the same difference in antennal ratio, and the markings on the head are much different.

Third Instar. Nymph six days old measured dorsally as follows: length of body along middle 4.880 mm.; width head across eyes 1.066 mm.; length of prothorax .476 mm.; greatest width of entire bug (near base of thorax) 1.407 mm.; length of intermediate tibia 3.087 mm.; length of antennal segments .635 mm., 363 mm., .408 mm., and .771 mm. Second antennal segment slightly heavier than in preceding instar and also darker apically, but not as much so as before.

Head.—Dorsum of head about as in second instar, with median brown line that extends forward of brown spot on head forking at its anterior end. Ventro-cephalad of brown spots mentioned in description of second stage, another pair (too far over curve to be visible from dorsal view of second instar, but visible if head is elevated when view is taken). By each of these last-named dots there is one long upright hair. Body.——Markings little different than in second instar. Brown spots on prothorax more irregular in outline, perhaps somewhat smaller in proportion to the pale portion. Brown median line on prothorax more distinct and now to be seen for the entire length of thorax excepting near anterior margin of mesothorax, where it, as well as prothoracic-mesothoracic suture is not evident. This portion is slightly darker. There is a darkening, perhaps a chitinization, of the angles of the meso-notum, probably indicating the beginning of the first pair of wings. There is also a beginning of a second chitinization slightly caudad of the first. The coloration of the bug as a whole perhaps a little darker than second instar. In the specimen before the writer the brown spots on the mesothorax are fainter and seem not to extend over on to the metathorax. In this and later instars the differences between this species and the cosmopolitan *G. rufoscutellatus* Latr. are many and great.

Fourth Instar. Nymph eight days old measured dorsally as follows: length of dorsi-meson 8.739 mm.; width head across eyes 1.452 mm.; length of prothorax .908 mm.; greatest width of mesothorax 2.088 mm.; length of intermediate tibia 5.062 mm.; length of antennal segments, 1.157 mm., .612 mm., .635 mm., and 1.112 mm. Apical end of second segment still slightly heavier.

Head.—Spot projected forward, about as far forward as second pair of dots which are now slightly farther apart. The branching now amounts to a shallow V shape only. Entire body darker, but otherwise not a great deal unlike third instar. Thorax.——Prothorax about the same as in third instar, with both brown and pale portions somewhat darker. The brown spots of the mesothorax of earlier stages extended to the outer sides and to the posterior margin, and now constitute the wing pads which extend .113 mm. beyond the junction of mesothorax and metathorax. Metathoracic wing pads extend .340 mm. beyond tips of mesothoracic wing pads. The wing pads of the mesothorax measure 1.362 mm. at their greatest width—the wing pads of the metathorax are slightly narrower. Each abdominal segment has a broad darker band (about .227 mm. wide) along the dorsi-meson and another band on either side. The median body line broadens at the anterior margin of both pro-and mesothorax and ends abruptly at the posterior margin of the mesothorax.

Fifth Instar. Nymph fifteen days old measured dorsally as follows: length of dorsi meson 10.464 mm.; width of head across eyes 1.657 mm.; length of prothorax 1.362 mm.; widest portion of bug (posterior margin of mesothorax) 2.179 mm.; length of intermediate tibia 6.583 mm.; length of antennal segments, 1.816 mm., .885 mm., .839 mm.; and 1.225 mm. Second segment remains the slenderest and slightly enlarged at tip.

Head.—Dark brown and hairy, but for a small orange spot just back of the base of the rostrum, and on laterodorsal margin near anterior margin of eyes where three black spots are faintly visible on a backround of obscure orange. Silvery pile just inside eyes and base of antennae. Thorax.——Prothorax has pale median portion reduced to little more than a line. Posterior third of prothorax is much swollen and raised and set off by a transverse depressed line. Brown spots of meso-and metathorax now reach the posterior margin of the prothorax and are continuous with wing pads. Wing pads extend to a distance of 3.859 mm. caudad of the posterior margin of prothorax, making them about on a line with the apex of the posterior coxa. About .908 mm. caudad of posterior margin of prothorax there are two narrow pale portions, about .454 mm. long, one on each side of the dorsi meson. Abdomen.——each segment has three dark and two pale longitudinal stripes, each segment of connexivum has two dark portions with a pale one in the center. The abdomen has as a result a striped appearance. The above-mentioned markings become fainter as the apex of the abdomen is reached and cannot be seen at all on the genital segments.

Description of adults.

Macropterous male No. 5-2. Dorsal View.——Length of head including anterior central lobe (visible from above), 1.443 mm.; length of anterior lobe of pronotum 1.135 mm.; length of posterior lobe 3.632 mm.; length from tip of tylus to apex of abdominal spines, 13.134

mm.; width, head across eyes 2.020 mm.; width of pronotum across humeri 2.043 mm.; length of intermediate tibia 9.307 mm.; length of antennal segments, 2.951 mm., 1.248 mm., .953 mm., and 1.475 mm.

Wings lack .454 mm. reaching to the tip of the abdomen (last genital segment). Apex of last genital segment falls a little short of abdominal spines. General color dark brown. Head and pronotum covered with closely-set dull aurichalceous pile which becomes longer at the sinuation of the inner margin of the eye, at base of antenna, and along laterodorsal edge of head from the anterior margin of eye to the tip of the tylus. Antennae brownish black, pile not so closely set. Orange-colored median line on anterior lobe of pronotum .908 mm. long and .113 mm. at its widest. This line is widest near the anterior margin of pronotum and diminishes in width as it progresses forward and backward. At the base of the head this orange stripe branches, the forks or branches extending forward and outward toward the eyes, which they come within .113 mm. of touching. Dorsi-meson of anterior pronotal lobe somewhat depressed, laterodorsal angles terminate anteriorly in prominent protuberances. Posterior lobe of pronotum with distinct median carina, very prominent humeri, rounded posteriorly with a broad explanate margin, lower half of lateral edge yellowish. Wings smoky brown, veins black and covered with pile not unlike that on head and pronotum. (Pile easily rubs off and for that reason often not present). With wings pushed aside, dorsum of abdomen blackish with a liberal coat of pile, medius obscurely pale (if pile be rubbed off, a broad irregular plumbeus stripe is seen). Legs with pallide-flavens pubescens. Upper half of sides of thorax of darker brown than dorsum. Connexivum narrowly yellow. Posterior margin of last abdominal segment and lateral margins of genital segments fulvous. Abdominal spines black above. Trochanters and basal portion of anterior femora tawny, femora have sharp projections apically.

Ventral View.——First two segments rostrum yellowish, third brown, fourth black, reaches beyond posterior margin of prosternum. Underside of head with dense growth of long grayish white hair. Prosternum, coxal cavities, trochanters, basal one fourth of femora, yellowish. Mesosternum ashy-grey, pallescent posteriorly, acetabular caps pallid. First one half or more of ventri-meson a furrow, becoming gradually shallower until it disappears beyond the middle of segment. Median line dark gray for entire length. To either side of furrow a slate-gray stripe (.3 mm. apart at anterior margin of medipectus) which becomes lighter in color as it proceeds caudo-dorsad toward acetabular caps. Entire mesosternum presents a beautiful velutinous appearance. Intermediate and posterior femora vary in color from yellow at their base, through fuscescent and light brown, to dark brown and finally brownish black at the apicies. Coxae yellowish and brownish, trochanters yellow. Intermediate and posterior legs pluri-spined. Post-pectus light gray like posterior portion of medipectus, with dark gray median line which enlarges near posterior margin to surround the omphalium. Omphalium is dull orange. Venter velvety gray with broad irregular band medianly, and occasional patches of silvery sericeous pubescence at incisures. Color variable. In a given specimen the venter may be silvery or black, depending upon how the light falls on it. Considerable yellow on ante-genital segment and on genital segments. Abdominal spines black excepting at base. Silky hair points median until near ventral median line than points posteriorly.

Some male specimens are smaller, others larger than the present specimen. It is perhaps about average size. Females similar to males but larger and more robust. Venter with posterior margin of last abdominal segment and first genital segment (excepting narrow black median keel) yellow. Brachypterous specimens commonly found. In some specimens the last three abdominal segments and a part of a fourth are visible, in others only two segments and a partial third are in evidence. Some of the macropterous forms have wings longer than the abdomen and almost if not quite as long as the abdominal spines.

Rearing Methods.

The laboratory methods employed in the rearing of this species were not those that would ordinarily be used by the writer in rearing this type of insect. The first instar nymphs were found at a time when the press of teaching and administrative work did not warrant undertaking life history studies. However, the nymphs were isolated with the idea of securing a few notes on their behavior in captivity. They were isolated in Syracuse watch glasses, petri dishes and other small glass containers and given house flies as food. The containers were placed along the back side of the writer's desk next to the wall where the bugs would not be disturbed by the movements of persons passing the desk. They ate greedily and soon molted. It could be seen by this time that with a little care the life history could be secured. After the third instar was reached most of the nymphs were transferred to tall stender disher similar to jelly glasses because they would escape from the shallow dishes every time the covers were lifted. Two methods were used to transfer the nymphs. They were either picked up by grasping a leg firmly with a pair of curved fine-pointed forceps or were scooped up by a sort of ladle fashioned out of brass into a shape similar to the spoons used by confectioners to serve ice cream sodas, but with a numbers of holes in the bowl portion. A small amount of water was placed in the life history jars but no vegetation or sand. More ideal breeding containers would have been large aquaria in which the water would have remained fresher and in which a small amount of water plants might have been grown. In these live food might have been placed for the strider nymphs. However, in spite of the cramped and in some respects undesirable quarters the bugs kept pace with those in nature, going through their nymphal development in the same time, as shown by daily field observation.

The adult bugs were as large as those found in nature with one exception. Male No. 5-29, reared in a jar one and three-fourths inches in depth and one and five-eighths in diameter, was smaller than the average male taken in nature. The container was so small in circumference that the intermediate and posterior legs could not be spread out their fuul length and had to be turned upward. A few specimens from among a large series of bugs taken in the field have been no larger than this reared specimen, but it is likely that some unfavorable condition in their environment, perhaps food shortage, was the cause. Nevertheless there is considerable variation in size, coloration etc. in this species of water strider. One full-size female was reared in a container seven-eighths inch in depth by one and three-fourths in diameter until the third instar was attained and after that in a container of the same depth but of two and one-fourth inches in diameter. The tall stenders mentioned above measured three and one-fourth inches in depth and two inches in diameter. Closely fitting glass lids were used on all containers. On several occasions the changing of the water in the breeding jars was neglected too long and the resulting pollution caused the body pile of the bugs to become gummy. If this is allowed to progress too far the bugs will become waterlogged and sinking, drown. In these cases this was avoided by placing a piece of index card about an inch square on the surface of the water and placing the bug upon the same. This permitted the nymph or adult to clean one leg without the others sinking as would have been the result without this aid.

It might be suspected that the high rate of mortality indicated by the following table of rearings was due to the smallness of the containers used but this is doubtful. The writer has reared five American species in the family Gerridae and found the mortality to be high in all of them regardless of the kind of container used. Members of this family normally use considerable space, in confinement their highly nervous dispositions cause them to dash themselves against the sides of their containers time and time again. *Trepobates pictus* H. S. and *Gerris remigis* Say are especially highly strung species. Seven of the two dozen nymphs which died either died attempting to molt or because of difficulty at molting time were deformed and for that reason killed by the writer. Many of the others it will be noted died at or near the time of molting and although the skin was not actually split preparatory to molting, it is likely that inability to molt caused death.

It is very difficult to observe living nymphs except at feeding time for they are almost continually on the move, and are sure to be when they perceive movement on the part of the observer. Notes on feeding habits and general behavior can be secured without difficulty but for a study of structure or coloration the specimens must be killed.

As might be excepted the adults reared in the laboratory are better contented in their restricted quarters than are those brought in from the outside, and as a result do not dart about so frantically. It is interesting to note that reared adults consume more food than do those brought in from nature, due no doubt to their having received more food (and it more regularly) throughout their nymphal existence. This holds true for various species. The nymphs of a species of Lethocerus found in this region form an interesting example of reaction to environment. Nymphs hatched in the laboratory or collected as first instar specimens are apparently satisfied with close quarters and thrive well, while those collected as third, fourth of fifth-stage nymphs spend a great deal of their time in an effort to effect an escape. When not attempting to escape they resort to death-feigning, a habit little resorted to by those reared from the start in the laboratory. Furthermore, the wild nymphs although consuming the same amount and the same kind of food as reared specimens, seldom reach maturity when brought into the laboratory. This would seem to indicate that their state of unrest, rather than faulty food or living conditions, causes their death.

Summary

From Table No. I it may be observed that seven specimens were reared to maturity, but three of this number were followed only from the third instar on. Of the seven three were males and four were females, six were macropterous, one brachypterous. There were five nymphal stages. The average length of the first instar could not be determined for only in one case, that of No. 5-29, was a first-instar specimen taken the day it hatched. The average duration of the second instar for twelve specimens was 6.4 days (minimum 5, maximum 9 days); the average length of the third-stage bugs for twelve specimens was 5.8 days (minimum 4, maximum 7 days); the developmental period for twelve fourths averaged 7.9 days (minimum 6, maximum 11 days); the seven fifth-stage nymphs lived 13.4 days as an average, with ten days as a minimum and fifteen days as a maximum. Allowing five days as the average length of the first instar, the duration of the nymphal existence is about 39 days. [Peculiarly enough it might be noted that the average duration of nymphal life for six specimens of *Trepobates pictus* H.S. (see Annals Ent. Soc. Amer., Vol. XVII, 1924, p. 423.) reared in America by the writer in 1923, was 39 days.] Adding a seven day incubation period we have a total of 46 days as the developmental period from egg to adult. As pointed out above this developmental period would no doubt be much shortened due to higher temperature, a little later in season. It is probable that the species may have five or six generations per year in this latitude.

The studies made thus far have not been complete enough to warrant the drawing of final conclusions as to the economic status of this insect in relation to fish propogation. Fish stomachs have not been extensively studied as yet but it is likely that such a study will reveal, that here as in America, the water striders constitute an almost negligible amount of the insect food taken. Their chief relation, then, to the insectivorous fishes is in the role of competitors for food. No data are available as to the amount of food consumed by the Gerrids but judging from the appetites of individual specimens in the laboratory as well as the numbers present in some fish ponds, they probably consume all of the terrestrial insect food that goes into such ponds. In addition to this they secure a great many aquatic insects as the latter emerge, and also some, at least, of those aquatics that remain in the water permanently. It is said that young trout in hatcheries, fed on ground pork and beef, can be saved from food-deficiency diseases if given one feed per week of insects, their natural food. With this in mind it can be seen that the insect food eaten by waterstriders, even if not extensive, has its place in the economy of nature.

TABLE I.

TABLE OF REARINGS OF COMMON CHINESE GERRID.

Rearing Number	First instar	Second instar	Third instar	Fourth instar	Fifth instar	Total Days	Sex	Date
5-2	4†	7	5	8	13	37†	m	1925 Apr.16
5-3	5†d	......	......	......	......	....	...	......
5-4	4†	5	6	8d	......	....	....	......
5-5	4†	5d	......	......	......	....	....	......
5-7	4†	7	6d	......	......	...	....	......
5-8	4†	4d	......	......	......	...	....	......
5-9	4†	10d	......	......	......	....	....	......
5-10	4†dm	......	......	......	......	...	...	......
5-11	6†d	......	......	......	......	...	....	......
5-12	2†	4d	......	......	......	...	....	......
5-13	4†	5d	......	......	......	....	...	......
5-14	4†	6	6	8	15d	....	...	......
5-15	4†	7	5	8	1k	....	....	......
5-16	3†	6	6	8	15	38†	f	Apr.19
5-17	5†dm	......	......	......	......	....	...	......
5-18	4†	6	6	8dm	......	....	..	......
5-19	4†	9	7	5d	......	....	....	......
5-20	3†	d	......	......	......	....	....	......
5-21	3†	1d	......	......	......	...	...	......
5-22	3†	1d	......	......	......	...	...	......
5-23	3*	......	......	......	......	...	...	......
5-24	3dm	......	......	......	......	....	....	......
5-26	4†	7	4	9	14	38†	f	Apr.17
5-28	2†	k	......	......	......	....	....	......
5-29	5	6	7	11	10	39	m	Apr.26
5-30	4†	6	7	11	6d	....	....	......
5-31	1†	5	5	7	15d	....	....	......
5-59	......	......	5†	7	15	...	f	Apr.14
5-60	......	......	4†	7	8d	....	....	......
5-61	......	......	6	7	15	....	m	Apr.19
5-75	......	......	7†	6	12	....	f	Apr.17
AVERAGE	......	6.4(12)	5.8(12)	7.9(12)	13.4(7)	....	....	......
MINIMUM	......	5	4	6	10	....	....	......
MAXIMUM	......	9	7	11	15	....	....	......

† = incomplete. d = died. dm = died molting. k = killed.

* = killed for specimen. m = male. f = female.

A PRELIMINARY NOTE ON THE LYCHEE STINK BUG (HETEROPTERA PENTATOMIDAE)*

By

RICHARD B. FALKENSTEIN

Observations on the common stink bug pest of the lychee and lungan fruit trees have been progressing for about nine months and although the investigations are far from being completed, a few notes on the life history and natural control of this insect may not be without interest at this time.

Tessaratoma papillosa Drur. belongs to the family Pentatomidae, order Hemiptera; it therefore possesses sucking mouth parts and obtains its food by piercing the bark of the younger stems and sucking out the sap. This insect is widely distributed throughout the Oriental region and has been recorded from India, Burma, Siam, Malacca, Sumatra, Java, the Philippines, south China and other places. However, this distribution may overlap that of a closely related species, *Tessaratoma javanica.* In and about India the bug feeds on the widely distributed "soapnut tree," *Sapindus trifoliatus*; so far as we have been able to determine it confines itself to the lychee, *Litchi chinensis* Sonn., and the lungan, *Euphoria longana* Lam., in this region.

The egg-laying season begins the latter part of March or first part of April and extends into July, the majority of the large green or yellow eggs being laid in May and first of June. These hatch in eleven days and the young complete development in five to eight weeks, depending upon temperature and other factors. The nymphs upon hatching soon begin feeding by inserting their beaks into the veins of the fresh leaves or shoots. The larger nymphs are especially fond of sucking the sap from the fruit stems when the fruit is filling out and it is a common thing to see from one to four nymphs gorging themselves with the sweet sap that should go toward making a bigger and more luscious fruit. The great toll of sap taken constitutes the chief injury to the host plants, an injury that is estimated to the amount of hundreds of thousands of dollars annually to the lychee and lungan crops in China.

The majority if not all the overwintering adults gradually die off during the summer, many being attacked by a fungus of the *Penicillium luteum* group. They remain on the twigs, grasping the latter much like grasshoppers which fall prey to the same disease. Here the dead bugs are attacked and eaten by the larva of a moth, probably *Myelois ceratoniae* Zell.

* Contribution from the Biological Laboratory.

The adult bugs winter over by congregating on the thick foliage of lychee, or of other trees if growing among them; thick, heavy foliage of the "wong p'ei", *Clausena lansium* (Lour) Skeels, is especially resistent to the cold winter winds and in local orchards the bugs are found in large bunches and in a more or less dormant condition. In the spring as the weather warms up they redistribute themselves; they are good fliers and are able to scatter over an extensive area.

This brings up the problem of control. Because of the nauseous smell emitted from the stink glands of both nymphs and adults, which is often given off with little provocation, they are little bothered by birds. However, one bird is worthy of special mention because it seems to take many of the eggs of this stink bug. This is the common Chinese bulbul, *Pycnonotus sinensis* (GM), popularly known as "paak t'au poh" or "paak t'au laan."

During the winter season the best opportunity is afforded to attack the insect, especially when hand picking is the method employed. In this off-season for the orchardists large numbers may be easily destroyed by collecting the clusters of inactive insects. The value of destroying the adults before the arrival of the egg-laying season is evident. However, since this bug is such a strong flier, (Chinese orchardists will testify to this), a co-operative campaign over a large section would be necessary for the best results. A systematic gathering of eggs is another helpful control method. After the nymphs are hatched it is both difficult and painful to attempt hand picking.

No attempt has yet been made by us to use contact sprays. The cost of such in this region, danger of burning the foliage, and difficulty of reaching the young bugs are factors that will have to be taken into consideration in their use.

Mention should be made here of two undetermined hymenopterous eggs parasites, one a Chalcid. These parasites constitute the main check on this bug and have been found to parasitize as high as 44% to 75% of the eggs in different areas. More work along the line of laboratory propagation of the parasites with the hope of increasing their effectiveness is planned, but it must be remembered that this will be met with certain difficulties including the upsetting of a natural balance between host, parasite, secondary parasites, if any, etc.

Besides further work on the parasitic control of this insect, the raising of individuals under known conditions of humidity and temperature will be carried out. Cultivation of the fungus which attacks the adult, and, it should be said, often the nymphs, suggests itself to us. On the other hand, the fungus spore already exists in the wild. It would be well to leave the bugs that have died of the fungus clinging to the trees. This would tend to increase the prevalence of the spores in the immediate area.

DEPARTMENTAL NOTES

AGRONOMY

Improving the Chinese Plow.

The Chinese plow is economical and quite suitable for the plowing of paddy lands, but it will not turn sod as effectively as the modern plow and also its point breaks very easily. Although the cost is only twenty-five to thirty cents per plow point the breakage sometimes amounts to large sums, and the task of putting on the points is a tedious one. Mr. Huhlein, of the Avery Plow Company of the United States, and who visited Canton in March of this year, is very much interested in the plow. He wished to study the plow in operation, with a view to making improvements, but unfortunately, due to unforseen delays was unable to pay a visit to the College. The department has sent to Mr. Huhlein a description of the plow along with a photo of the same, and we hope that an improved plow will be forthcoming before long.

Increasing Kwangtung's Rice Prodcution.

A maxim of the country folk is to the effect that Kwangtung's rice crop is not sufficient for one breakfast of its people, and while this is not true, we cannot deny the fact that the rice production of the province is not sufficient to supply its population. This is clearly shown by the customs reports, according to which Kwangtung imports about fifteen million piculs (picul equals 133.3 lbs.) of rice annually. This figure does not include those imported and consumed in Hongkong and Macao, and furthermore the importation is increasing each year. It requires about three million mow or about six hundred thousand acres of land to produce the fifteen million or more piculs.

Has Kwangtung that much land that might be used for rice production? Yes, it is estimated that there are millions of acres of marshy river-deposited land that could be reclaimed. One reclamation expert has said that there exists enough reclaimable land in Heungshan district alone to produce the amount of rice imported annually. Land reclamation, however, is a big task and one that requires both capital and protection from pirates. We hope the government will soon be in a position to give serious consideration to supplying this capital and protection.

Information at hand from different districts indicates that a great deal of land has been abandoned because of political strife, robbery, and clan feuds. This abandonment will continue and perhaps increase if the present situation be not changed. If political strife would cease and if the government would devise methods of protection for the farmers, the production of rice from these abandoned lands would be enormous.

The above-mentioned considerations are more or less political and do not come within the province of the Agronomy Department, but the improvement of the yield of rice is within our power, and it is our desire to improve the yield of upland rice as a means of increasing rice production. The field of rice breeding is hardly touched in this province, and the presence of many elementary species should make the task less difficult.

Upland rice has always been regarded as inferior in yield and therefore unprofitable. Tests reveal that even the yield of our selected upland rice, is from twenty-five to thirty per cent less than lowland rice. However, it requires much less labor in its production and is just as profitable, if not more so, than other crops which could be grown on the same kind of soil.

Our average for upland rice is about two hundred and fifty catties of patty, which brings about fifteen dollars or more. After the rice harvest the land may be planted to sweet potato and that followed by a legume, such as soy bean or pea, at the end of the year. If upland rice could be made to increase in yield as a result of breeding and selection, the farmers would grow more of it on land where the water supply is insufficient for the production of lowland rice. There is much land of this nature in the province and the production of more rice on this upland which might otherwise lie idle for a part of the year. would be a considerable addition to the total rice production of the province. The Department of Agronomy is now testing and breeding about a dozen varieties of these upland rices and we hope that by improving the yield and quality of these, we may contribute toward increased rice production in the province.

Rice Yield.

A very good yield of rice is reported from the different districts is spite of the recent destructive storm.

ANIMAL HUSBANDRY

During the past few years the Department has made a considerable increase in the number of breeding animals, especially in dairy buffalo cows and swine. Although we have not yet removed all our live stock barns to our permanent location on the animal husbandry section west of the southwest athletic field, this section has been developed to a great extent. A brick silo with a capacity of fifty ton was built two years age, the draft animal and goat sheds were contructed last year, a temporary bull shed has just been finished and the poultry houses are now almost completed. Guinea grass and pigeon pea are growing over all areas not used for buildings and are cut for filling the silo. An ensilage machine, presented by Papec Machine Company of Shortsville New York is used for cutting silage and elevating it into the silo. The power is furnished by the four horse power engine given by the Associated Manufacturers, of Waterloo, Iowa. This engine has been used almost continuously for eight years for pumping water for the College, and as a result it no longer gives entire satisfaction for running this machine.

The work of the past few years of collecting data on breeding, weighing milk production, calf-raising, butterfat testing, and feeding experiments is being continued. The Indian buffalo cows which were secured two years ago are giving a fair amount of milk. Some cows show an increase of 15% since their arrival at the College. With regard to percentage of fat, the milk of some cows contains as much as 10½% fat, but the average is about 2% less than in the milk of the local buffaloes. Some of the cows have very long lactation periods, being almost a year.

A study of the growth of the Indian calves, shows them to occupy an intermediate position, that is, growing much faster than local buffalo calves and a little slower than Holstein calves. Two of our heifers will be fresh within the next few months, at the age of 3½ years. The detailed record will appear, later, in the Lingnaam Agricultural Review.

Our Holstein cows are doing well. The Holstein heifer presented by ex-Governor Frank O. Lowden of Oregon, Illinois, came fresh last fall, giving over 20 pounds of milk. The other two heifers will be fresh within a few months. Foreign cattle are much more susceptible to disease than are the local cows. The Holstein bull now weighs 2000 lbs. and is doing incely. Besides giving service to our cows and heifers he also gives service to cows of other dairies and especially to cows of the Ling Nan Agricultural Manufacturing Company. At present we have two well selected local buffalo bulls, three Indian buffalo bulls and two Holstein bulls. The other Holstein bull is a young bull which was born last spring. A temporary bull shed has been built on Animal Husbandry Hill.

BIOLOGY

Survey.

The biological survey which has been under way for a number of years is being continued. While this project includes a survey of the fauna and flora of South China it is being made more intensively, at the present, in Kwangtung province. To facilitate handling of the material the survey work has been divided into two categories, the botanical and the zoological.

The botanical work centers around the herbarium which is under the immediate direction of Mr. McClure, who is also associated with the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture. During the past school year about 750 or 800 numbers have been added to the herbarium and several large shipments of plants made. The herbarium now contains about 1200 numbers, representing between six and eight thousand species.

The herbarium policy is to make our collection of plants as representative as possible, but special emphasis is being placed upon the economic forms. During the present year much effort has been spent on the collection of bamboo, and in the course of the work Mr. McClure has discovered some characters of great taxonomic value. It is expected to make a complete survey of the bamboos of the province with a view to clarifying the systematic relationship of the group. Studies of the vegetative characters seem quite promising in this direction.

Close touch is being kept with the specialists in the different groups and material is being constantly sent away for identification.

In the zoological part of the survery the economic phase is also being stressed, but material of all sorts is being collected and all available data gathered. Because of a research project under way special emphasis is being placed on aquatic organisms. A biological, ecological and taxonomical study is being made of the aquatics. A collection of fishes and various collections of insects have been sent to specialists for naming. New equipment has been added and the insect collection is being rapidly built up.

Research

Full teaching schedules limit the amount of time available for research, but during the preparation of courses to fit local conditions and while studying and making use of local materials, some new facts have been ascertained and some forms new to science found.

Mr. Falkenstein is carrying along as a research problem a study of the Hemipterous family Pentatomidae, with especial reference to the stink-bug which is so destructive to the lychee and the lungan. This pest is of tremendous importance to the farmers of Kwangtung and neighboring provinces since it damages their crops to the estimated extent of hundreds of thousands of dollars annually. The life history of this fairly widely distributed pest has been worked out in a general way by Kershaw (1907), but a more detailed study, especially stressing the ecological factors, is being undertaken by Mr. Falkenstein. Mr. Falkenstein's preliminary notes on this work appear elsewhere in this number.

Mr. Hoffmann is carrying on some research projects with fish and other aquatic organisms. All phases of the propogation of freshwater fishes are being investigated. Three experimental ponds have been constructed to provide for experiments with stagmant water fish culture. The work will be carried on a larger scale next year and will include experiments with freshwater ponds. Data relative to marine fisheries is also being gathered. Mr. Hoffmann as Secretary of the Committee on Fisheries and Marine Biology of the Pan Pacific Union has been asked by that organization to be responsible for a survey of the past and present conditions of the Fisheries of China, with a view to initiating improvements, and especially international cooperation and regulation. Similar surveys are being made for the other Pacific countries and it is expected that the task will require three or four years for completion.

The work with aquatic insects is largely but not altogether in connection with their relation to fishery problems. The Hemiptera is the first group to be studied, primarily because it is a group known to Mr. Hoffmann taxonomically. All aquatic Hemiptera will be studied in detail regardless of their economic relation to fish propogation.

Cooperation.

The department of biology is cooperating with specialists and institutions in China and elsewhere in so far as time and funds permit, and it is hoped that these relationships may be extended during the coming year. This cooperation has consisted of sending materials to those needing them for monographs, making identifications, investigational work, and making trips into the interior with visiting specialists. One interesting trip of this sort was made with Dr. Albert Herre, Chief of the Division of Fisheries, of the Philippine Bureau of Science. On this trip ten thousand small fish, carp, were purchased by Dr. Herre for the purpose of propagation in Philippine waters. A good per cent of the fish reached their destination alive and Dr. Herre informs us that they seem to be thriving in their new environment.

Another investigational trip was made with Dr. E. C. Faust of the Department of Parasitology of the Peking Union Medical College. The details of this trip are given elsewhere in this publication.

Some local collecting was done in company with Dr. F. Silvestri of Portici, Italy, who paid a second visit to the College early in May. Unfortunately much of the material of the first collection which Dr. Silvestri made in Kwangtung spoiled enroute to America. We sincerely hope he was more usccessful in his second attempt.

Dr. D. T. Fullaway of the Board of Forestry and Agriculture, Territory of Hawaii spent a day with us in February and made plans for a more extensive stay later. at which time he expects to rear and study possible parasites of *Adoretus sinicus,* the so-called Japanese Beetle which is such a destructive pest in Hawaii. Mr. Fullaway expects to spend eight months in the Orient.

Mr. H. A. Jaynes, Entomologist in the Bureau of Entomology, United States Department of Agriculture visited us early in March. Mr. Jaynes is interested in the true Japanese beetle, *Popillia japonica. P. japonica* is found only in Japan, but other species of the genus are found in China, the Philippines, India and other places. Mr. Jaynes is associated with Messrs. King, Clausen and Gardner in the Japanese beetle work. The entire proceedure of securing and sending parasitized grubs to America is very interesting and we were given a real treat when Mr. Jaynes gave a talk to our class in economic entomology on this subject.

Special Problems.

A number of students have become interested in particular problems in biology and four of the senior agricultural students have made plans to work out biological problems for their theses. Two of the students are studying fish propagation, each a different phase of the subject, one student is working on the stink bugs which attack citrus and the fourth student plans to take up a limnological problem. Each will find unlimited opportunity for research and in all probability will secure information which may be put to practical application. Early in the summer the department constructed a research and rearing laboratory and installed rearing tables and other necessary equipment.

SERICULTURE

The silk market has been very much depressed during the past two months. The market for crop III came just at the time when the strike began and all cocoon warehouses and markets were closed. The farmers lost heavily. No raw silk has been exported from Canton during the past seven weeks. The markets for crop IV are now open as the prospects for the export of raw silk are more favorable. Many filatures are beginning to open again. The government has given permission for export of silk by way of Shanghai and several consignments are now ready for shipment.

The strike and closing of all markets made it necessary for the Department of Sericulture of the Ling Nan Agricultural College to reduce its work during crop IV to only what worms were necessary to keep the stock alive. But with the returning export of raw silk and the opening of markets and filatures it will be possible in crop V to run at full capacity once more.

The Atwood Reeling Laboratory is now complete except for the reeling equipment and plumbing. Much of the material for this arrived in Hongkong just before the strike began and as soon as a permit can be secured from the government to bring it to Canton the equipment will be installed and the building ready for work.

The government some time ago granted a special sum of money to the Kwangtung Provincial Bureau for the Improvement of Sericulture with which to conduct investigations into the best improved methods of reeling Canton cocoons. As soon as the equipment is installed these investigations will begin in the Atwood Reeling Laboratory. In fact some work has already been begun with foot power reels. For this work Mr. Chui Hok Ching has been appointed as assistant in charge.

At the end of April the Department of Sericulture issued Agricultural Bulletin number 12 in English and number 13 in Chinese. This bulletin is entitled A Survey of the Silk Industry of South China. The report covers 208 pages with two maps and four pages of half tone cuts. It attempts to give a resume of the silk industry in all its phases as it now exists in South China. Copies of this report can be secured from the Department of Sericulture in either English or Chinese for one dollar each. The Department wishes to express its gratitude to former Governor Liao Chung Hoi who by a grant to the Department made it possible to conduct the survey upon which this report is based.

* * *

GENERAL NOTES

Educational Activities, Ling Nan Agricultural College.

The regular Commencement and Closing Exercises of the College were held this year on June 22nd, instead of 25th. in view of the seamens' strike. This year we had four candidates for the degree of Bachelor of Science in Agriculture. The degrees were granted in Swasey Hall, and at the same time, Two-Year Junior Certificates in the Agricultural College were granted to six men. Short Course (One Year) Certificates were presented to four men and one woman.

Chinese Egg Factories.

It is interesting to note that there are in China to-day thirty-one egg factories, among which five of the leading foreign companies are located in Shanghai. These companies deal in frozen eggs and products as well as fresh eggs. The China Egg Produce Company, Shanghai, perhaps does considerably the most business.

Fishery Protection.

A fishery protection corps has recently been organized in the Province of Kiangsu, known as the Kiangsu Coast Volunteer Corps, for the protection of fishing and sailing vessels along the coast of that Province. The corps will have two steam crafts and twenty armed boats for inspection work. The steamers will be used also for experimenting with modern methods of fishing. The headquarters of the corps is at Woosung.

A New Method of Curing Peach Tree Diseases.

A new method of curing various kinds of peach tree diseases has recently been discovered by the members of the Department of Entomology of the Southeastern University in Nanking. They are now offering their services to the Nanking public gratis. Those who are interested in this new method, can address the Department of that University, Nanking.

Beancake Exports.

Next to nightsoil, beancake is perhaps the most important fertilizer to be dealt in commercially and to be used most extensively by Chinese farmers. Besides, it is exported in considerable quantities, chiefly to Japan, Korea, and Russia. Of the 24,785,869 piculs, valued at HK. $56,866,201, which China shipped during 1923, Japan received 20,084,176 piculs, Russian Pacific ports 4,026,532 piculs, Korea 478,349 piculs, the United States 166,420 piculs, and Great Britain 11,681 piculs. Others consuming smaller quantities were Denmark, Germany, Canada, Siam, and British India.

Manchurian Bean Exports.

Exports of Manchurian beans between November, 1924, and March, 1925, totaled 872,427 ton. These were shipped through Dairen, Vladivostok and Newchwang as follow:

From	Ton
Dairen	434,306
Vladivostck	395,202
Newchwang	42,919

The total for the year is estimated as follows:

From	Ton
Dairen	734,840
Vladivostok	449,000
Newchwang	77,770
Total......	1,261,610

Wood Oil at Chungking, Szechwan Province.

The exports of wood oil from Chungking during 1924 reach the respectable total of nearly 83,000 piculs, valued at HK. Tls. 1,500,000.00 in round numbers. The following figures show the gradual development of the trade:—

	Piculs	HK. Tls.
1920	33	470
1921	89	1,007
1922	1,876	17,784
1923	23,272	431,696
1924	82,917	1,457,681

A New Agricultural Journal in Foochow, Fukien.

A new paper known as "Lung Pao" (農報), dealing entirely with agricultural subjects, has been published by the Union of Foochow Agricultural Associations. The first issue appeared in Foochow on May first. It is hoped that later we can keep our readers informed of the contents of this and other papers appearing in Chinese.

Parasitological Studies in Kwangtung.

Dr. Ernest Carroll Faust of the Parasitology Laboratory of the Department of Pathology, Peking Union Medical College, has recently made some investigations on the epidemiology of Clonorchis (Chinese liver-fluke) infection in this province. With Canton Christain College as his headquarters he spent the first two weeks of February in this work, after which he went to the Swatow area for further studies. The Hookworm Committee of Canton Christain College cooperated with Dr. Faust, and Dr. Oldt and Mr. Hoffmann of the Committee accompanied Dr. Faust on a trip to Siulam in the Heungshan district, where with the splendid help of Dr. A. D. Cook and with Dr. Oldt's wide acquaintance in the district, a great deal was accomplished in a short time. Siulam was selected for the investigation because the records of the China Hookworm Commission showed a very high per centage of infection among the farmers of this region. The investigational trip to Siulam revealed that the mulberry region offered favorable conditions for Clonorchis infection as it had also been shown to offer for Hookworm infection. The information secured relative to Clonorchis will not be discussed here inasmuch as Dr. Faust expects soon to publish a paper disclosing his findings.

Observations relative to the relationship of night-soil disposal to the freshwater fisheries, human health and agriculture, substantiated our intimation in the preceding number of this journal as to the significance of this complex problem. We knew something of the problem before coming to China because the records of the San Francisco Immigration Station indicated that Canton was a center of infection. Chinese, mostly from Canton and surrounding territory, examined at San Francisco preliminary to admission to the United States, were found to be heavily infected. Chinese ship crews have shown as high as thirty per cent infection, while earlier observers have found as high as forty per cent infestation in natives about Canton. Some time ago Dr. W. W. Cort stated that about twenty species of fresh-water fish have been reported as serving as the second intermediate host of Clonorchis. Since that time additional intermediate hosts have been reported by Faust and Kobayashi.

The problem of Clonorchis prevention is not one of easy solution. It would be idle talk to advise the Chinese farmers not to feed night soil to fish and not to use infected soil from the bottom of the ponds as fertilizer for mulberry, lychee and guava, unless at the same time one could tell them of a substitute that is just as good and just as economical. Rendering night soil non-infective without at the same time reducing its value as a fertilizer presents another problem. Even if this could be accomplished it would be hard to get the practice of treating it generally adopted unless there was some additional advantage to be secured. If the fertilizing value of night soil could at the same time be increased or if some material not now used for fertilizer could be utilized along with it, the practice of night soil treatment might become quite generally adopted. It is with these points in mind that the fertilizer-night soil experiments are being carried on by the Hookworm Committee. Experimental fish feeding will throw light on the possibility of an economical substitute for night soil for fish food. It was for this purpose that three experimental fish ponds were constructed last spring, but owing to disturbed conditions in the country the work has not progressed.

The Hookworm Committee of the College decided to enlarge the scope of its investigations and experiments to include a further survey of Clonorchis infection in men and fishes and experiments with night soil storage and Clonorchis viability, much in the same manner as has been carried on for hookworm. In accordance with this decision a sub-committee was formed to take up the question of setting up special experiments on mulberry, while another sub-committee was appointed to take up the question of construction of proper equipment for mixing garbage with night soil for experimental observation. The study of fish-cultural practices as related to parasitology was to be continued as outlined a year ago by the Biology Department.

Dr. Faust asked Drs. Cadbury and Oldt to make some studies on the epidemiology of Clonorchiasis, making use of records obtained by the Canton Hospital. He further asked Mr. Hoffmann to attend to the identification of the fishes involved and to bring together the information concerning Clonorchis from the fisheries standpoint. Unfortunately the disturbances of the past summer made it impossible to accomplish very much toward the completion of this work.

Conferences in the Pacific.

The preliminary announcement of the program of the Third Pan-Pacific Science Congress, to be held in Tokyo October 27 to November 9, 1926, has been sent out. It is indeed gratifying to know that Japan is able to carry out plans for this big conference in spite of the great calamity of September 1923, before the occurrence of which the invitations for the Conference had been sent out. Following the great success of the First and Second Pan-Pacific Science Congresses held in Hawaii in 1920 and in Australia in 1923, the third conference will undoubtedly be a big one. The objects of the Conference, in the main, are to promote cooperation in the study of the scientific problems of the Pacific and to strengthen the peace-relations among Pacific countries. The tentative programs have been planned in the form of symposia upon given subjects, three of which have been placed tentatively in the general sessions and sixteen in the divisional sessions. The idea of having general sessions in the mornings and divisional meetings in the afternoons follows the plan of the First Pan-Pacific Food Conservation Conference held in Honolulu in 1924. The divisional sections of the Third Pan-Pacific Science Congress as they now stand include: (1) Division of Physical Sciences, (2) Division of Biological Sciences. The National Research Council of Japan will direct the Congress, while the Pan-Pacific Association of Japan will have charge of the entertainment of the guests.

Early in October there is to be held in Honolulu a conference of men interested in the fisheries of the Pacific countries. Plans will be made for the Pan-Pacific Research Institute fisheries work and further plans made toward initiating international regulation of certain fisheries. The survey work which will lead up to recommendations for international regulation was instituted by the Committee on Fisheries, Marine Biology and Oceanography of the Pan-Pacific Union shortly after the close of the Food Conservation Conference last year. Mr. William E. Hoffmann of Canton Christain College was invited to take part in the meeting held in October, but was unable to leave his work for such a long period.

The Teaching of Biology in China.

The editor of the China Journal of Science and Arts in a discussion of the teaching of biology in the institutions of higher learning in China points out that this important branch of science is at last coming to the fore in China, but that it has not yet really come into its own. The discussion further points out that students have in the past been slow to take up biological studies because they could not see the practical value of such. It is quite true that Chinese students are now beginning to see the "why" for biological study. The sign of the times points to a rapid growth in biological studies in China. Aside from the failure to see the practical side of biology there are other reasons for this biological lethargy as it were. We do not have the beginnings of biological studies in the lower grades of school, as we do in countries where biology has a higher standing. We do not have our nature study groups for the young children and we have very little biological instruction in the middle or high school. Students should have an opportunity to commence their biological work in the middle school and here the lack of suitable textbooks will be found still greater, perhaps, than in the College. The establishment of the teaching of biology in the middle schools will go a long way toward bringing biology into its own in China.

The publishing of short semi-popular accounts of the natural history of plants and animals, in our scientific journals and periodicals, will do much to increase interest in biology. Faunal and floral lists have their place, but they are of little value to our young students, and what is more they must be supplemented with biological and eological data if they are to be of much value to specialists, other than catalogers. What good does it do us to know that such and such a plant or animal exists in our country if we know nothing else about the organism?

The Summer Institutes for Science Teachers will render much service to the biological cause. It is to be regretted that the one which was to have been held the past summer had to be postponed until next year. The institutes will do much for standardizing the teaching of biology, will put the different teachers in touch with each other, and if held in a different region each year willl give biologists an opportunity to see different biotical realms.

Ling Nan Agricultural College Staff

Mr. Li Chun Jung, D. V. M., has recently been added to the staff of the Agricultural College. Dr. Li has just returned from America where he spent six years at Iowa State College taking the combined course in Animal Husbandry and Veterinary Medicine. While in America Dr. Li had considerable practical experience in serum plants, packing houses and in veterinary practice, all of which will come in good stead in his new field of work.

Mr. Clinton N. Laird, M.A., Professor of Chemistry, has just returned from furlough in the United States. Most of the year was spent in Baltimore where he worked under Dr E. V McCollum in the School of Hygiene and Public Health, Johns Hopkins University. His problem involved a comparison of the rat and the pidgeon in testing for vitamin B. The data showed that results obtained under similar conditions with the two kinds of animals can not be compared directly. A paper on the subject is to be published shortly by E. V. McCollum and C. N. Laird.

Mr. Chui Hok Ching has recently been appointed as research man in the Kwangtung Provincial Bureau for the Improvement of Sericulture. Mr. Chui has just returned from America where he took his degree at the University of Minnesota. He is well trained in science and will prove a valuable man for this work.

Mr. Tong Iu Tso has been appointed as Graduate Assistant in the Department of Sericulture of the College. Mr. Tong took his bachelors degree last June at the Ling Nan Agricultural College, having specialized in Sericulture. He has shown special aptitude in this work and will prove a valuable addition to the staff of the Department.

* * *

REVIEWS

BUREAU OF ENTOMOLOGY, CHEKIANG, KASHING CHINA. *Marauga diffusa* as a Pest of Rice (Noctuidae). Pop. Bull. 4, 16 pp., 1 fig. 1924. (in Chinese). Abstracted in *The Review of Applied Entomology.* Vol. XIII. Ser. A. part 5. p. 226.

Marauga diffusa, Wlk. is a great pest of rice in the western part of the Province. 122 of 483 larvae were parasitized by Braconid, Chalcid, and other Hymenoptera, 12 were attacked by a fungus. W. E. H.

CHAMRERLAIN, JOSEPH CONRAD. The Citrus Coccidae of the World. An Appeal For Co-operation and Aid. *Bulletin of Entomological Research.* Vol. XV. part 3, pp. 281 & 282.

While this article does not have particular reference to China, it is of sufficient interest to entomologists and agriculturists in China to warrant mention here. As the title indicates, the article is in the nature of an appeal. Late in 1924, under the auspices of the Citrus Experiment Station of the University of California, Riverside, California, the tremendous task of monographing the Citrus Coccidae of the world was undertaken. This monograph is intended, not as a systematic treatise merely, but to be a general account of all that is known about this group of insects, including complete bibliography and what is more important a correlation of these data with the distribution and importance of commercial citrus plantings. The writer points out that the proposed work will be of value to many other than those directly or indirectly interested in citrus. As a help to those who expect to co-operate in this fine work the following points were given.

1. "A list of *all citrus* scale-insects or mealy-bugs attacking in *any degree* commercial or ornamental plantings of any of the varieties of *Citrus*, with notes as to their relative economic importance in the district (which may be large or small) under consideration."

2. "Alternate and preferred hosts."

3. "Actual specimens or material—particularly of rare or sporadic and "Unknown" species".

4. "Extent, acreage, varieties and approximate value of the "raw' citrus products. (This information is readily available only for the United States, Spain, Algeria, Italy and possibly Palestine.) These data are desired, as before noted, to facilitate the closest possible correlation between the extent and value of *Citrus* plantings themselves and the geographical distribution and economic danger of the pests".

5. "Local common names".

It is to be hoped that Entomologists in China and elsewhere in the Orient will give their full co-operation to this highly important work. W. E. H.

CHINESE GOVERNMENT BUREAU OF ECONOMIC INFORMATION. Roses as a Foodstuff. *Chinese Economic Bulletin*, number 224.

Two kinds of roses are cultivated in Nanking the imported kind and the native kind. The latter kind is highly scented and retains its fragrance for months and even years. The dried petals can be kept for a year or two without losing their fragrance. Because of this characteristic the native roses are much sought after by the Nanking public for food scenting. Besides scenting tea leaves and drinks, roses are also used in the preparation of various kinds of food such as candy, light refreshments, pastry, cakes, etc. The rose petals are preserved either by drying them in the sun and keeping them in jars as such or by preserving them in syrup. In either case, they can be kept for a year or more.

The market price for roses is very cheap, owing probably to extensive cultivation, and the price varies according to weather conditions. The market for fresh roses is over in less than a week. In Nanking alone, nearly 10,000,000 pieces of roses are gathered every year, valued at between $15,000 and $20,000,00 Mex. C. K. C.

CHINESE GOVERNMENT BUREAU OF ECONOMIC INFORMATION. Wood Oil Business in Wanhsien, Szechwan. *Chinese Economic Bulletin*, number 224.

Aleurites fordii, the wood-oil-bearing tree, is found in abundance in the district of Wanhsien and up-country of Szechwan Province. Naturally there are many factories for the treatment of the seeds or nuts. The business seems to have been well organized in that district. This article gives in a very concise way the method of handling the oil, the process of making and the cost of production. C. K. C.

CHINESE GOVERNMENT BUREAU OF ECONOMIC INFORMATION. How Hupeh Farmers Raise Loans. *Chinese Economic Bulletin*, number 224.

The author describes the three methods by which Hupeh farmers contract loans namely, (1) loans from friends, (2) loans from money-lenders, and (3) loans from saving societies. (Note:—These are also methods used elsewhere in China). The last named method is perhaps the most peculiar It is a convenient method of saving on the one hand and of borrowing on the other. The organizer of the society gets a loan from a number of persons without paying any interest, but obligates himself to act as the guarantor for the repayment of the loan. A concrete example of how this is worked out is described in this article. C. K. C.

CHINESE GOVERNMENT BUREAU OF ECONOMIC INFORMATION. Program of Reafforestation in Shansi. *Chinese Economic Bulletin*, number 225.

At a recent Industrial Conference held in Taiyuan, a program for Reafforestation, which had been outlined by the Shansi authorities, was passed. The program covers three periods totaling 50 years, during which 177,459,000 mow is to be reafforested. Investigations made by the Shansi Afforestation Bureau in 1918 indicate that the forested area of the Province covers 1,242,259 mow, or 0.177 per cent of the total area of the whole Province which is estimated at 700,000,000 mow. As preliminary steps towards the consummation of the program, Shansi authorities will measure and register all waste land and an association for the promotion of afforestation will be organized in each village to be responsible for local afforestation affairs. So far, over 50,000 mow of land has been planted in timber trees during the past four years (1921-1924), each mow planted with 120 trees. Beginning with 1931 or thereabouts, the authorities expect to fell 3,000 mow of timber every year. During the first four years, only 60 trees a mow will be cut. Estimating each felled tree at $0.30, an annual income of $54,000 each of the first four years is expected. The remaining trees will increase in size and value. After ten years, the price per tree is estimated at $1 50 instead of $0.30 The total proceeds of 3,000 mow of 60 trees each will then amount to $270,000 annually. With these proceeds, the authorities will carry out the various measures set forth in the program. Much of this program is theoretical, perhaps, but it is a good thing for the people to think about the important question of reafforestation in China. C. K. C.

CHINESE GOVERNMENT BUREAU OF ECONOMIC INFORMATION. Shad as a Table Delicacy. *Chinese Economic Bulletin,* number 230.

Illisha elongata, the shad, known in Chinese as the "Shih Yu" is a marine fish that migrates to fresh water during the spawning season. Fishermen living along the Yangtze River catch it in large numbers every year. In the sea, the fish is not easily caught. But during the migratory season, i. e., from the end of May to the end of June, large shoals are found in the lower reaches of the Yangtze River. The fish come up the river with the tides as far as Wuhu. When they enter the Yangtze Estuary and get to Chinkiang, they are caught in large numbers. By the time they reach Wuhu the number is greatly decreased. The article goes on to describe a native method of preparing the fish for table and quotes the market price of $0.25 to $0.80 per catty according to supply. C. K. C.

COMBSTOCK, JOHN HENRY. An Introduction to Entomology. *The Combstock Publishing Company.* Ithaca, New York. 1044 pages. 1924.

This entomology text while written for use in America will be found very serviceable for use in China. It is in a way a revision of "A Manual for the Study of Insects" published a score and a half years ago. In the preface the author states that the name has been changed because so many changes and additions were found necessary in the revision of the "Manual". Part I of the present volume was published separately in 1919 but many changes have been made since then. Part I treats of the structure and metamorphosis of insects while the second part treats of the classification and life-histories of insects. The first chapter takes up the characteristics of insects and their near relatives. Chapters two and three take up the external and the internal anatomy, while chapter four is devoted to a discussion of metamorphosis. Part II has the first chapter on the sub-classes and the orders of the class Hexapoda with the following twenty-five chapters each dealing with a separate order of insects. At the end of the book there is nineteen pages of bibliography, containing only papers and books mentioned in the text. Some interesting new departures have been made in the matter of classifying insects to orders. A very useful feature of the book is that of referring to recent monographs on particular groups. The book throughout shows the wide acquaintance with the literature so characteristic of Professor Combstock. Because of smaller margins and smaller type the book is but little larger than the "Manual" although it contains nearly two times as much material. The book is nicely put up and makes a good addition to any biological library. W. E. H.

FEY, K. Y. How to Control the House-flies. Shanghai Commercial Press, 1922. (in Chinese). Abstracted in *The Review of Applied Entomology.* Vol. XIII. Ser. B. p. 169.

Detailed descriptions of six species occurring in Southeastern China, with brief descriptions of house-flies in general, their life history, habits and control. W. E. H.

FEY, K. Y. Delfax infesting Rice at Chekiang. Bur. Ent. Chekiang. Kashing, Pop. Bull. 5, 14 pp., 1. pl., 1 fig. Chekiang China. Aug. 1924. (In Chinese) Abstracted in *The Review of Applied Entomology.* Vol. XIII. Ser. A. part 5. p. 227.

As long ago as 1578 B. C. outbreaks of this pest occurred in the western part of Chekiang Province. At that time the remedy consisted of shaking off the insects and pouring cabbage oil and wood oil on the surface of the water. This treatment has been supplanted by petroleum, a better remedy. There are several species of Delphax involved. W. E. H.

HESSE, R. Zerstorung von Bleirohren durch Tiere. [Destruction of Lead-tubing by Animals]. Biol. Zentralbl., XIV, No. 1, pp. 1920, 2 figs. Leipsig, 1925. Abstrated in *The Review of Applied Entomology*. Vol. XIII. Ser. A. part 5. p. 227.

In addition to beetles (*Tetropium*, *Hylotrupes*) and wood wasps that bite into lead, a *Zylocopa* bee made holes in the lead cable covering at Shanghai. W. E. H.

LIEU, D. K. Food Conservation in China. *Mid-Pacific Magazine*, Vol. XXIX. No. 3, pp. 511-519, seven illustrations.

This is a paper prepared for the Pan-Pacific Food Conservation Conference held last summer in Honolulu in which the author states that food conservation is not a new thing in China. He traces the practice to the Chow dynasty (1122-220 B. C.), when a rule was formulated by a great statesman that every generation should keep enough grain on reserve to provide for nine years of famine. Later, in the period of Tsun-chiu (4th.-6th. countries B. C.) Kuantze, a statesman and leader of political thought of that time, outlined a plan by which the feudal lord would buy grain when its price fell below a certain limit and sell when it went above that. Imperial barns were established where grain surplus was stored. The author believes such a system may work even to-day only on a more scientific basis so that the grain can be stored longer without being spoiled. He also believes that better transportation facilities are necessary for the conservation of all kinds of foodstuffs.

C. K. C.

PING, C. The Development of the Fish Industry in China. *Mid-Pacific Magazine*, Vol. XXIX, No. 3, pp. 567-573, six illustrations.

This is a paper prepared for the Pan-Pacific Food Conservation Conference in which Dr. Ping points out the great possibility of developing China's fish industry, because China has nine provinces bordered by the sea and the people living along the coast depend largely on fish and other kinds of sea products for food. The fact that fishing seasons last all the year round is another great possibility. The author gives the present day conditions of fishing in Manchuria, Shantung, Kiangsu, Chekiang, Fukien and Kwangtung; and states that the income of the people from fishing is great but is gradually decreasing due to the lack of scientific training and discipline on the part of the fishermen whose incessant fishing is depleting most of the rare species. The latter is true of Chinese fishermen as well as of fishermen from neighboring countries. He believes that Pacific nations should establish an international court which would be entrusted with the authority of governing fishing on the ocean, so as to determine to what extent each country has its fishing area from its own coast and what species of food fish each country should catch or preserve at certain times of the year. Such a court would do away with many disputes between Pacific nations regarding fishing rights. C. K. C.

SOWERBY, ARTHUR DE CARLE. The Fisheries of China. *Mid-Pacific Magazine*, Vol. XXIX, No. 4, pp. 653-663, eight illustrations.

This is a paper prepared for the Pan-Pacific Food Conservation Conference. The author points out that economic development and conservation of natural resources will surely help China to a place of honor amongst the nations, and, in order to bring this about, all kinds of well equiped institutions should be established to carry out scientific research—museums, biological and chemical laboratories fishery, forestry and agricultural experimental stations. To develop the fish industry is only one of the many possible economic developments of China. He deplores the careless and the most unscientific way of catching the fresh water fish and the inadequate means employed in catching the marine fish. The discussion throughout is based more or less upon his observation and his suggestions are quite acceptable to the Chinese. C. K. C.

TAKAHASHI, R. Some Aphididae From China. *Trans. Nat. Hist. Soc. Formosa,* Vol. XIV. No 73, pp. 55 & 56. Abstracted in *The Review of Applied Entomology.* Vol. XIII. Ser. A. Part 4, p. 141.

At present thirty-three species of Aphids are known to occur in China. The following are recorded for the first time from this country, most of them having been collected in Nanking: *Macrosiphum mishigaharae*, Essig & K. *Rhopalosiphum nymphacae* L., *Aphis medicaginis*, Koch, *Anuraphis pyri*, Mats., *Hyalopterus arundinis*, F. (*pruni*, F.), *Periphyllus kodreuteriae*. Tak., *Pterochlorus tropicalis*, v. d. G. W. E. H.

Notice to Subscribers.

Owing to unavoidable circumstances we are in arrear in the publication of the Review, but all numbers will be issued eventually and there shall be no break in its continuity. It is expected that Volume 3, No. 2 will appear by the last of the present year.

LINGNAAM AGRICULTURAL REVIEW.

The Lingnaam Agricultural Review is published twice each year by the Ling Nan Agricultural College, Canton Christian College, Canton, China. The publications of this college are issued chiefly in the Chinese language. It is the purpose of this publication to give a review of the activities of the college in the field of agriculture, and especially to record the findings of its experimental and research work.

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THE EFFECT OF TREATMENT OF PERSONS INFECTED WITH HOOKWORM AS CHECKED BY EGG COUNTS.

By Wm. W. Cadbury. M.D.

Canton Christian College, Canton, China.

Early in 1924 we (1) published a report on the results of treatment of workmen infected with hookworm. The examinations before and after treatment were made by the salt-flotation method and either oil of chenopodium or carbon tetrachloride was used for the treatment. It was found that by one treatment with oil of chenopodium 58 per cent of cases were cured, as judged by subsequent fecal examination. Of those who received only one treatment with carbon tetrachloride 3 to 6 cc., only 36 per cent were freed of worms.

The disadvantage of this method of procedure is that one can get no idea of the relative improvement in cases not completely rid of the parasite. It was therefore suggested to the writer by Drs. W. W. Cort and N. R. Stoll that a study be made of the effect of treatment in reducing the egg count in the stool of persons harboring hookworms.

During Dr. Cort's visit to the Canton Christian College in connection with the survey of the China Hookworm Commission, a large number of egg counts were made. These included workmen on the College campus, some villagers from nearby, and several village school children. Advantage was taken of these counts and three or four months later treatments were given and subsequent counts were made in order to determine what proportion had been wholly rid of the parasite and in the remaining what was the percentage reduction of ova in the stool.

The method of making egg-counts is that worked out by Stoll (2). A specimen of stool is carefully weighed to five grams. This is then diluted with decinormal sodium hydroxide solution to 75 cc. The specimen is mixed with glass beads, thoroughly shaken, and .15cc. is removed by a graduated pipette and placed under a cover glass measuring 24 x 50 mm. All eggs are counted from two slides and the average noted. For a diarrhoea stool multiply this average by 4, for a mushy stool multiply by 2 and for a formed specimen take the number of ova as counted. In any case by this method one determines the number of ova per .01 gram of stool. Therefore if one multiplies the result by 100 one has the number of ova per gram of stool.

By reference to the attached table one may note the results in each case. Altogether 45 of the subjects who had an egg count made were treated at the Ling Naam Hospital, and were subsequently again examined for ova by the count method. Of these forty-five cases 39 were male and 6 female, 39 were laborers or servants, one was a soldier and five were village school children. One of the cases, No. D 112, was treated twice with an interval of six months and egg counts were made before and after each treatment. There was thus a total of 46 treatments.

Medicine was given early in the morning on a fasting stomach. A mixture composed of carbon tetrachloride eleven parts and oil of chenopodium one part was used. Of this mixture .2 cc. was given for each year of age up to a maximum of 3 cc. (3). At the same time a saturated solution of magnesium sulphate was given (4).

As the result of treatment the following was the outcome:

Total cures	—25	(54 per cent)
Improved	—20	(43 per cent)
Stationary	— 1	(2 per cent)

The cures compare favorably with the results previously obtained by using oil of chenopodium. The advantage of the method here employed is that it gives one the opportunity to estimate the percentage improvement in cases that were not completely cured

If now we take the sum of ova counted per .01 gram of feces for all the 45 cases, before they were treated, we get the figure 900. The sum after treatment is 179.3, leaving an actual reduction of 720.7. This figure stands for the actual reduction of ova per .01 gram of feces for the whole series or an average of 80 per cent. The same results may be arrived at by taking the average of all the per cent reductions of the cases as indicated in the last column of the table. While only 54 per cent were completely rid of ova, there was 26 per cent more than this of reduction in the number of ova counted.

It is unfortunate that such a long interval elapsed from the time of treatment to the final count. In the 18 cases in which this interval was less than one month there were 67 per cent in which all ova disappeared and the percentage reduction for the whole number was 88 per cent. For the 27 cases in which a period of one and a half to five months elapsed between the treatment and the final examination there were only 48 per cent of cures indicated and the reduction in the egg counts was only 77 per cent. There was undoubtedly an opportunity in this series for a reinfection. This is also borne out by reference to the table. In the fourth and fifth columns it is noted that 16 of the patients had been previously found infected with hookworm. Moreover they received from one to three treatments following which twelve, at least, of them were found to be free of ova by the salt-flotation method. This was in 1922 or 1923. In spite of this result all the sixteen were found to be infected when egg counts were made in April or later in 1924. It seems likely that reinfection had occurred during the year or more that had elapsed.

We have compared the results of treatment of these cases with the results in those not previously treated. Of the 16 who received medicine in 1923, only 6 (37 per cent) were freed of ova by the 1924 treatment. There was a reduction of 69 per cent in the egg counts. Of the 29 who had not been previously treated 19 (66 per cent) were completely cured and there was 89 per cent reduction in the egg count. This compares favorably with our figures for the whole group—54 per cent of cures and 80 per cent reduction in the counts. May we not conclude that those cases which had previously received medication had become or were before more resistant to treatment than those which had not formerly taken any medicine?

Summary.

The "egg count" method is a satisfactory basis for estimating the degree of improvement following treatment of cases infected with hookworm.

A reduction of the infection by eighty per cent may be expected by employing the carbon tetrachloride-oil of chenopodium mixture, together with a dose of magnesium sulphate.

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TABLE SHOWING THE RESULT OF TREATMENT ON THE NUMBER OF HOOKWORM OVA COUNTED IN THE STOOL.

Hosp. No.	Sex	Age	No. Prev. Tr.	Result Prev. Tr. 1922-1923	Count of Ova before Tr.		Count of Ova after Tr.		Date Tr.	Time after first Exam.	Time betw. Tr. and second Exam.	Per cent. Hw. Reduction.
					Date 1924	No.	Date 1924	No.	1924			
5	M	35	2	Cure	Apr.	65	Oct. 6	43	Jul.	3 mos.	2 1/2 mos.	34
8	F	12	0		Apr.	2	Jul. 21	0	Jul. 15	3 mos.	6 day	100
20	M	9	0		Apr.	8	Nov. 22	0	Jul. 22	3 mos.	4 mos.	100
21	M	11	0		Apr.	14	Nov. 27	8	Jul. 22	3 mos.	4 mos.	43
22	M	15	0		Apr.	8	Jul. 31	0	Jul. 23	3 mos.	8 days	100
24	M	49	2	Cure	Apr.	44	Sept. 18	8	Jul. 24	3 mos.	2 mos.	82
25	M	30	3	Cure	Apr.	36	Jul. 28	15	Jul. 24	3 mos.	4 days	58
26	M	23	3	Cure	Apr.	81	Dec. 14	22	Jul. 25	3 mos.	5 mos.	73
27	M	33	2	not cured	Apr.	7	Sept. 30	3	Jul. 25	3 mos.	2 mos.	57
29	M	21	0		Apr.	8	Dec. 27	3	Jul. 25	3 mos.	5 mos.	63
30	M	42	0		Apr.	24	Sept. 26	0	Jul. 26	3 mos.	2 mos.	100
32	M	43	0		Apr.	70	Sept. 29	11	Jul. 26	3 mos.	2 mos.	84
33	M	25	3	Cure	Apr.	10	Sept. 26	8	Jul. 26	3 mos.	2 mos.	20
37	M	52	2	Cure	Apr.	4	Sept. 29	3	Jul. 28	3 mos.	2 mos.	25
39	M	15	0		Jul. 21 22 23 Av.	47 11 47 35	Nov. 25	0	Jul. 25	2 days	4 mos.	100
40	M	27	0		Jul. 21 22 23 Av.	0 3 5 3	Sept. 29 Oct. 1 Oct. 2 Av.	1 0 0 .3	Jul. 28	5 days	2 mos.	88
42	M	27	1	Cure	Apr.	11	Dec. 3	0	Jul.	3 mos.	4 mos.	100
43	M	31	1	Cure	Apr.	1	Sept. 19	0	Jul. 29	3 mos.	2 mos.	100
44	M	33	3	Cure	Apr.	2	Jan. 4	1	Sept. 8	5 mos.	4 mos.	50
45	M	22	1	?	Apr.	14	Nov. 30	8	Jul. 29	3 mos.	4 mos.	43
52	M	21	0		Apr.	18	Sept. 29	0	Aug. 6	4 mos.	1 1/2 mos.	100
53	M	31	0		Apr.	14	Sept. 29	0	Aug. 6	4 mos.	1 1/2 mos.	100
54	M	35	1	?	Apr.	2	Sept. 29	0	Aug. 6	4 mos.	1 1/2 mos.	100
55	M	25	0		Apr.	11	Nov. 30	0	Aug. 6	4 mos.	4 mos.	100
56	M	52	0		Apr.	19	Sept. 13	0	Aug. 6	4 mos.	1 mo.	100
57	M	20	0		Apr.	46	Sept. 20	10	Aug. 6	4 mos.	1 mo.	78
58	M	40	0		Apr.	11	Sept. 13	0	Aug. 6	4 mos.	1 mo.	100
59	M	50	0		Apr.	1	Sept. 20	0	Aug. 6	4 mos.	1 1/2 mos.	100
60	M	25	1	Cure	Apr.	1	Jan.4.'25	0	Sept. 8	5 mos.	4 mos.	100
61	M	29	0		Apr.	10	Sept. 29	0	Sept. 8	5 mos.	3 wks.	100
62	M	22	0		Apr.	6	Sept 18	0	Sept. 8	5 mos.	10 days	100
63	M	22	0		Apr.	15	Sept. 18	0	Sept. 8	5 mos.	10 days	100
67	M	28	1	Cure	Apr.	13	Sept. 19	5	Sept. 9	5 mos.	10 days	62
68	M	30	0		Apr.	16	Sept. 18	11	Sept. 9	5 mos.	9 days	31
70	M	37	2	Cure	Apr.	10	Jan. 5.25	0	Sept. 10	5 mos.	4 mos.	100
79	M	45	0		Apr.	11	Oct. 7	5	Sept. 26	5 mos.	11 days	53
85	M	20	1	?	Oct.	6	Nov. 26	0	Nov. 20	1 mo.	6 days	100
D 112	F	40	0		May	16	Nov. 27	4	Jun.	1 mo.	5 mos.	75
"	"	"			Nov.	4	Dec. 27	4	Dec. 14	7 days	23 days	0
120	M	39	0		Nov. 22	16	Nov. 26	0	Nov. 23	1 day	3 days	100
140	M	34	0		Nov. 10	2	Jan. 5	0	Dec. 29	1 mo.	7 days	100
D 154	F	50	0		Apr.	183	Jun. 16	2	May 28	2 mos.	1 mo.	99
D 294	F	12	0		Apr.	2	Jul. 19	0	Jun. 10	2 mos.	1 mo.	100
D 366	F	21	0		Jul. 24	12	Nov. 18	5	Jul. 28	4 days	4 mos.	58
D 378	F	27	0		Jul. 24	2	Sept. 29	0	Jul. 25	1 day	2 mos.	100
D 934	M	25	0		Oct. 23 Nov. 3 Nov. 7 Nov. 8 Av.	7 5 5 7 6	Nov. 24 Nov. 25 Nov. 26 Av.	0 0 0 0	Nov. 15	7 days	9 days.	100

TREATMENT OF ASCARIS AND TRICHURIS INFECTION CHECKED BY EGG COUNTS.

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In the preceding paper the writer has analyzed the egg counts of 45 subjects whose stools were counted before and after treatment and in all of whom hookworm ova were demonstrated before treatment. Medicine was given early in the morning on a fasting stomach. A mixture composed of carbon tetrachloride eleven parts and oil of chenopodium one part, was used. Two tenths of a cubic centimeter of this mixture were given for each year of age up to a maximum of three cubic centimeters for adults. At the same time a saturated solution of magnesium sulphate was given. As the result of this treatment 54 per cent of the cases were rendered negative for hookworm ova. In 43 per cent there was a decrease in the egg-count and in 2 per cent there was no change. For the whole series there was a reduction in the count of hookworm ova of 80 per cent.

In making the counts for hookworm the ova of Ascaris and Trichuris were also always counted and among the 45 hookworm cases which were treated there were 33 in which Ascaris or Trichuris ova, or both, were found at the first examination.

No. of cases with both Ascaris and Trichuris ova—20 (61 per cent)
No. of cases with Ascaris ova only .... —27 (82 ,,)
No. of cases with Ascaris ova only .... —27 (82 ,,)

Taking first the 27 cases of Ascaris infection it may be noted that in No. 52 there was an increase from 2 to 67 ova after treatment, although the Trichuris count showed a reduction of 92 per cent. Since five months had elapsed between the two counts a reinfection might easily have occurred. The same is true of Case No. 60 in which nine months elapsed between the two examinations and an increase of Ascaris ova was found after the treatment.

Eliminating these two cases there remain 25 in whom there was a decrease in the egg-count following the treatment. Whether we take the sum total of ova counted before treatment and compare with the total counted after treatment or whether we take the average of the percentage reductions in all the cases the result is the same, namely a total reduction of 95 per cent of the ova. In 19 (76 per cent) no ova at all were demonstrated after treatment, thus constituting a cure in this number of cases. The improvement here noted followed upon one treatment only, but it must be admitted that opportunity for reinfection occurred both between the time of first examination and that of treatment as well as between the time of treatment and the second examination in several of the cases.

Taking up next the cases that showed infection with *Trichuris trichiura*, we may note that there were 27 in which ova were found in the first examination. Following treatment the number was reduced in all but one. In this one case, No. 45, there were counted four ova before the treatment and 14 after, with a lapse of seven months in between. Thus there remain 26 cases which showed an improvement. In these the average of all the percentage reductions for all the cases was 84 per cent. In 12 (46 per cent) there was apparently complete removal of the parasite from the intestinal tract, since no ova at all were found in the second count, after the one treatment.

Conclusions.

The use of a carbon tetrachloride-oil of chenopodium mixture in the treatment of patients infected with *Ascaris lumbricoides* and *Trichuris trichiura,* combined with a dose of magnesium sulphate, is highly efficient.

In cases of Ascaris infection a complete cure may be brought about in 76 per cent of cases and the average reduction in the number of ova counted in all the cases is 95 per cent.

In cases of Trichuris infection there may be a complete cure in 46 per cent and an average reduction in all cases of 48 per cent.

* * *

THE RESULTS OF TREATMENT UPON THE NUMBER OF OVA OF *ASCARIS LUMBBRICOIDES* AND *TRICHURIS TRICHIURA* AS COUNTED IN THE STOOL.

Case No.	Sex	Age	Date first count 1924	Ascaris ova counted	Tricuris ova counted	Date second count 1924	Asc. ova	Tric. ova	Date Treat. 1924	Per centage Reduction in count	
										Asc.	Tric.
5	M	35	Apr.	5	56	Oct.	0	1	Jul. 24	100	98
8	F	12	Apr.	231	17	Jul. 21	22	10	Jul. 15	91	41
20	M	9	Apr.	596	24	Nov. 22	16	4	Jul. 22	97	83
21	M	11	Apr.	240	47	Nov. 27	33	35	Jul. 22	86	26
24	M	49	Apr.	0	2	Sept. 18	0	1	Jul. 24	0	50
26	M	23	Apr.	281	26	Dec. 14	60	0	Jul. 25	78	100
29	M	21	Apr.	7	0	Dec. 27	0	0	Jul. 25	100	0
32	M	43	Apr.	97	6	Sept. 29	0	0	Jul. 26	100	100
33	M	25	Apr.	12	7	Sept. 26	0	2	Jul. 26	100	71
37	M	52	Apr.	0	16	Sept. 29	0	0	Jul. 28	0	100
39	M	15	Jul. 21 ,, 22 ,, 23	392 233 486	20 10 24						
			Av.	371	18	Nov. 25	0	2	Jul. 25	100	89
40	M	27	Jul. 21 ,, 22 ,, 23	7.5 18.5 11	0 0 0						
			Av.	12	0	Oct. 2	0	0	Jul. 28	100	0
42	M	27	Apr.	0	1	Dec. 3	0	0	Jul. 21	0	100
45	M	22	Apr.	11	4	Nov. 30	0	14	Jul. 29	100	*
52	M	21	Apr.	2	12	Sept. 29	67	1	Aug. 6	*	92
53	M	31	Apr.	933	21	Sept. 29	23	0	Aug. 6	98	100
54	M	35	Apr.	0	3	Sept. 29	0	0	Aug. 6	0	100
55	M	25	Apr.	74	0	Nov. 30	0	0	Aug. 6	100	0
57	M	20	Apr.	0	23	Sept. 20	0	14	Aug. 6	0	39
58	M	40	Apr.	33	6	Sept. 13	0	0	Aug. 6	100	100
59	M	50	Apr.	14	0	Sept. 20	0	0	Aug. 6	100	0
60	M	25	Apr.	0	2	Jan. 4. 1925	4	0	Sept. 8	*	100
62	M	22	Apr.	0	7	Sept 18	0	0	Sept. 8	0	100
63	M	22	Apr.	171	11	Sept. 18	0	0	Sept. 8	100	100
67	M	28	Apr.	54	3	Sept. 19	23	0	Sept. 9	48	100
68	M	30	Apr.	1	0	Sept. 18	0	0	Sept. 9	100	0
79	M	45	Apr.	103	0	Oct. 7	0	0	Sept. 26	100	0
D 112	F	40	May	92	14	Nov. 27	0	0	June	100	100
140	M	34	Nov.	2	28	Jan. 5 1925	0	4	Dec. 29	100	86
D 154	F	50	Apr.	32	46	Jun. 16	0	10	May 28	100	78
D 294	F	12	Apr.	535	11	Jul. 19	0	3	Jun. 10	100	73
D 366	F	21	Jul. 24	14	6	Nov. 18	0	3	Jul. 28	100	50
D 934	M	25	Oct. 23 Nov. 3 Nov. 7 Nov. 8	25 56 41 15	1 2 1 1	Nov. 26	0	0	Nov. 15	100	100
			Av.	34	1						

* Increase of ova counted, probably due to fresh infection.

SOME PRELIMINARY NOTES ON PERSIMMONS IN KWANGTUNG.*

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The persimmon, *Diospyros kaki* L., belongs to the Ebony family, other members of which produce woods of commercial importance because of their extreme hardness and striking color. Other species of this genus produce fruits of value, both as esculents and as sources of dyes.

Diospyros kaki L., hereinafter spoken of as the persimmon, is said to be native to China (Popenoe, Manual of Tropical and Subtropical Fruits, p. 355). A great number of horticultural varieties have been developed here which are as yet little known and very imperfectly distinguished. It is with the idea of making a beginning at standardizing the varieties found in this province that this paper is written.

Cultural Notes

The persimmon is grafted on its own stock entirely, seedlings of any variety being used without preference. Grafting is done in February or March, the stock having previously been set in the desired location and usually allowed to reach a diameter of about 1.5 to 2 cm. or an age of 2 or 3 years. The stock is cut back to a height of three or four inches and the scion, which is usually of 2-year-old wood, is inserted by means of a cleft graft. The graft is then covered with clay which is bound on with straw and watered at sufficiently frequent intervals to keep it moist for about twenty days, after which time the fate of the scion is evident. Trees are sometimes grafted when as much as six or eight years old, in which case the union is made at a height of 1 to 1.5 m.

Growing trees are sometimes manured in the spring, but as a rule mature trees are not fertilized. The orchards at Liu Tsoi (鎏 才) receive a heavy dressing of pond mud every year.

The trees come into bearing one or two years after being grafted, depending upon the age of the stock. One hundred and fifty to two hundred catties is considered to be a fair yield for a mature tree.

The culture of persimmons is widely distributed in the province. For the most part the trees are not grown under regular orchard conditions, but singly, or in twos or threes on the village commons, at the edge of a pond or canal, or distributed irregularly among other fruit trees. However, in the vicinity of Liu Tsoi (寥才), upper Poon Ue (番禺) District, one finds orchards composed solely of persimmon trees, up to 150 in number, planted at regular intervals in straight rows. These orchards are one of the important sources of the persimmons which appear on the Canton markets. The trees there are very long-lived, and one finds among them some of the largest and most shapely specimens to be found in the province. One tree measured 60 cm. in diameter 1.5 m. above ground, and 10 m. in height, and had a spread of 12 m. For the most part, however, the persimmon trees which one sees about the province are rather small and ill-shaped, probably due in part to the extreme predilection which certain parasitic plants (species of Loranthus and Viscum) have for this tree, which results in serious mutilation either through the death of the branches attacked or their removal by trimming, and partly to heavy bearing which results in very serious pruning both by natural breakage and by carelessness in picking the fruits.

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* Contribution from the Biological Laboratory.

Persimmon trees are also commonly attacked by two scale insects, *Tachardia fici* Green and *Aulacaspis pentagona* (Targ.) The extent of the damage done by these is not known. A yellowish brown ant is often found inhabiting cavities in the branches and even the small twigs. Their presence is usually revealed by a slight swelling in the affected part, and by an inconspicuous small round aperture which is the entrance to the hollow. The wood immediately surrounding the cavity is black, in contrast to the light color of the normal wood of the tree. The bark shows no special difference in color.

Ants are said by the farmers commonly to effect entrance into the twigs or branches through injuries which occasion the excretion of a gum which the ants like. Following the gum-saturated tissue they soon eat out a cavity. For this reason thoughtful farmers, when they trim their persimmon trees, plaster the wounds with mud to keep away the ants.

Harvesting Notes

The persimmon season usually begins early in August. The first variety to appear on the market is the small one known as *Kai Sam Tsz* (鷄心柿). The season lasts, as a rule, until the end of October, and a few fruits may be found on the market as late as the middle of November.

The fruits of a given tree do not all ripen at once. On the contrary, they may ripen a few at a time over a period of a month or two. This is true of *Taai Hung Tsz* (大紅柿) at Liu Tsoi (寥才). The fruits are taken from the trees when they have begun to turn yellow but while they are still quite firm. This is necessary in order that they may ship or keep well. If intended for the large markets, like Canton, they are packed in bamboo baskets of open weave, of about a bushel capacity, which are lined top and bottom with persimmon leaves in order to prevent the fruits from being bruised in shipping. The sides are left open for ventilation. They are then transported to the nearest railroad or navigable stream by wheelbarrow or carrier and thence to the large markets by train or boat. For local use the persimmons are stored temporarily in a cool, well-ventilated place. Anything that prevents proper ventilation or raises the temperature of the fruits tends to soften them.

The Ripening Process

All the persimmons thus far investigated, with the exception of the fruits from one tree of *Sz Man Chuen* (No. 9) at Loh Kong Tung, must be ripened artificially in order to remove the astringent quality due to the presence of tannin, which would otherwise make them inedible. This artificial ripening is accomplished by one of two general methods. One is the lime-water method, and all persimmons ripened by this method are known as *Ngaang Tsz* (硬柿), that is, Hard Persimmons, or *Shui Tsz* (水柿), that is, Water Persimmons. The other is the smothering method, called in Chinese, *Kuk* (究). The persimmons ripened by this method are known as *Nam Tsz* (棯子), that is, Soft Persimmons. This classification is very generally followed, certain varieties being spoken of as hard, or water persimmons, and others being spoken of as soft persimmons. However, by actual experiment, the writer has found that this classification does not hold, for it is possible to ripen a given persimmon by either method. Whether or not certain varieties are especially adapted to one or the other of these two methods has not been determined.

In the lime-water method the fruits are simply placed in large earthen jars or wooden tubs in water to which lime has been added at the rate of one catty to ten catties of water. The process takes from two or three days to more than a week, depending upon the variety, the state of ripeness of the fruits when harvested, and the length of time which has expired between harvesting and treating. Water Persimmons are readily recognized in the markets by the white bloom-like coating of lime with which they are covered. The merchants handle them very carefully in order not to mar this covering. The skin of water persimmons is golden yellow until allowed to become over-ripe, when it takes on a deep, orange-red hue. In the condition in which they are usually consumed, the flesh of water persimmons is firm, slightly juicy to mellow, depending upon the stage of ripeness, and mildly sweet. It becomes soft and mushy if the fruits are allowed to become over-ripe. They do not reach this stage as quickly as do the fruits ripened by the smothering method and by virtue of this better keeping quality they usually bring a little better price in the market.

A modification of the lime-water method used in the Tung On (東安) region consists in substituting for the lime an equal portion of the juice from the macerated stems of Hon Laat Liu (旱辣蓼) *Polygonum spp.*

The smothering method of ripening persimmons may be carried out in any one of several ways. The one most commonly used in the wholesale fruit markets in Canton is to place the fruits in a large, covered earthen jar in the middle of which is an upright bamboo cylinder of open weave. A large stick of incense is burned in this central chamber and the smoke, penetrating the spaces between the fruits is said to effect, or assist in, the ripening process. This is the most rapid method, being said to require only one or two days. Persimmons ripened by this process are deep orange-red in color, with golden yellow flesh, which is almost custard-like in its consistency, with the exception of the tougher, clear, almost jelly-like seed pocket, and may be eaten readily with a spoon. The fruits ripened by this method must be consumed promptly as they are very perishable.

The method most commonly used in the villages, where small quantities of persimmons are ripened for home consumption, is to place the fruits in a covered earthen jar, the bottom of which has first been covered with a thick layer of fresh banyan leaves. Another thick layer of fresh banyan leaves is then placed over the fruits and the jar covered. This process takes four days to a week or so.

The village boys sometimes ripen fruits for their own consumption by burying them in the mud for a few days!

Other Methods of Treatment

Among the Hakkas of Kwangtung persimmons are often dried for winter consumption. For this purpose the fruits are not ripened, but are picked while still firm, but turning yellow. They are then peeled, tied by their stems into long strings, and hung in the sun. As the surface gets dry enough so that the fruits may be handled, they are rubbed between the hands, presumably to assist in the expulsion of the moisture, and finally pressed flat. This product is known as *Tsz Peng* (柿餅), that is, Persimmon Cakes. The flavor is rich and pleasant, and not too sweet. There is usually no trace of astringency.

The Hakkas somtimes soak the freshly gathered fruits in salt water for about a week. This removes the astringency and imparts an unusual, but not altogether unpleasant flavor.

Other Uses of Persimmons in Kwangtung

A large portion of the persimmon crop, particularly of the smaller varieties, is never allowed to reach complete maturity, but is picked at the age of about three months and used as a source of two commercial products which are locally very important, namely, a black dye for dyeing silk, paper fans and fish nets, and a waterproofing material for paper umbrellas. The processes by which these products are made have not yet been investigated. The fruits of *Diospyros lotus* L., known locally as *Kaau Tsai* (膠仔), are used solely for these two purposes. This species is found wild in many parts of Kwangtung. It is cultivated at Loh Kong Tung, (羅崗洞) where it also occurs in the wild state. The seedlings which spring up spontaneously, both in the wild and on the cultivated hillsides, are grafted when about 1.5 to 2 cm. in diameter, with a strain which produces larger fruits than those borne by seedling trees. The fruits are small (up to 2 cm. in diameter), globose, very hard and seedy, with little flesh; yellow in color when ripe. See Figure 17.

Description of Varieties

1. *Kai Sam Tsz* (雞心柿)

Reported from Loh Kong Tung (羅崗洞), Lung Ngaan Tung (龍眼洞), Liu Tsoi (寥才), and Honam Island (河南) at Pak Shaan (北山) and Sheung Ch'ung (上涌). *Kai Tsz* (雞 柿) and *Tsz Tsai* (柿 仔), are also names sometimes applied to this variety. This is one of the most common varieties. In fact, it is a group of forms more or less similar in appearance. Some of the forms are distinguished by special names, while others, equally distinctive, are known only by the general name, *Kai Sam Tsz.* Figure 1 shows a very unusual, pointed form found on the market in Canton during October. It is said to come from Kaang Koo Lau (更鼓樓) and Ma P'oon (馬 盤). Figure 2 shows a form secured at T'in Ha Village, (田下村) Honam Island (河南) which is marked by a constriction about its middle. *Kwai Fa Tsz* (桂花柿) (Figure 3) is a seedless form found at Pak Shaan, Honam Island (北山,河南). *Man Tsz* (文 柿) (Figure 4) is a seedy form found at Loh Kong Tung (羅崗洞). *Kai Ngaan Tsz* (雞眼柿) (Figure 5) is a globular, rather seedy form, also from Loh Kong Tung (羅崗洞) (Shui Sai 水 西). *Ah P'oh Tuet* (亞婆啐) is a very small, seedless form found at at Foh Ts'uen (火 村) Loh Kong Tung (羅洞洞).

Often a tree bears both seedless and seedy fruits. The seedy fruits are always larger than the seedless, and are said to ripen earlier. The farmers call them the female (Na 乸) fruits. The seedless fruits are called male (Kung 公).

As a rule the fruits of this group begin to ripen about a month earlier than those of the other varieties, appearing on the market early in August.

2. *Ngau Sam Tsz* (牛心柿)

Reported from Lung Ngaan Tung (龍眼洞) and Loh Kong Tung (羅崗洞).

One of the largest varieties. Fruits cardiform, squarish in cross-section, apex flattened, calyx markedly depressed, skin and flesh light yellow. Astringent until ripened artificially. Seedless to few-seeded. Often with a slender tubular cavity at the core of the fruits. Figure 6

3. *Taai Hung Tsz* (大紅柿)

Reported from Liu Tsoi (寥才), Lung Ngaan Tung(龍眼洞), and from Loh Kong Tung as *Taai Yuk Tsz* (大肉柿). One of the large varieties, being 5 to 6 cm. in diameter. The most common variety on the market in Canton. Fruits cardiform, apex somewhat pointed, round in cross-section. Skin bright red when ripe, flesh golden yellow. Seedless to few-seeded. Must be ripened artificially. Known in the wholesale markets as *Taai Tsz* (大柿) and *Fuk Tsz* (福柿). Season very long, extending from the latter part of August into November, long after all other varieties have disappeared from the markets. Flesh very rich and sweet when ripe, and almost of the consistency of custard when ripened by the smothering method. Figure 7.

4. *Fong Tsz* (方柿)

Seen in the market at Cheung Chow (長洲) New Territories, Hongkong. Reported also from Koon Laan (觀瀾) in Tung Koon District (東莞) where it is known as *Hop Loh Tsz* (盒羅柿). Found near Ch'eung Kong (長江) where it is known as *Pin Tsz* (扁柿).

Fruits markedly oblate, squarish in cross section, up to 5 cm. in diameter. Stem attached in slight depression. Skin bright red, flesh golden yellow, sweet, of excellent flavor and quality. Seedless. Must be artificially ripened. Figure 8.

5. *Shai Tsz* (晒柿)

Reported from the vicinity of Tak Hing (德慶) and adjacent territory, including the Tung On region (東安).

Known in the Canton markets as *Tung On Shui Tsz* (東安水柿), *Taai Hung Shui Tsz* (大紅水柿), *Taai Tsz* (大柿) and *Shui Tsz* (水柿). The name *Shai Tsz* (晒柿) comes from the fact that these persimmons are commonly dried for winter consumption.

This is one of the largest varieties, attaining a diameter of 7.3 cm. and a length of 6.3 cm. Fruits oblong-conical, the apex flattened and sometimes with a slight depression. Somewhat squarish in cross-section. Calyx only slightly depressed, calyx lobes lying flat, never reflexed. Fruits seedless or nearly so. Usually ripened by the lime-water method, which results in a fruit with a most delicious, rich, moderately sweet flavor and a mellow texture. This is by far the best variety found by the writer. Skin and flesh a rich golden yellow to orange. Figure 9.

6. *Sha Hok Tsz* (沙壳柿)

Reported from Loh Kong Tung (羅崗洞). Known at *Foh Ts'uen* (火村) also as *Taai Tsz* (大柿).

Fruits oblong, cylindrical, round in cross section, calyx slightly cupped, calyx lobes usually sharply reflexed. Seedless to few-seeded. Characterized by a granular deposit (presumably of calcium pectinate) just under the skin, which gives a slight grating sound when the skin is cut with a knife, and which is the basis for the name *Sha Hok Tsz* (沙壳柿). Skin red-orange to orange-red when ripe. Flesh golden yellow; of excellent quality and flavor after artificial ripening, which is usually done by the smothering method. Figure 10.

7. *Shui Tsz* (水柿)

Reported from Loh Kong Tung (羅崗洞), Chuk Liu (竹寮) and Ch'eung Kong (長江) West River.

Fruits squarish in cross section, oblate, to sub-globular, with a marked depression running down the middle of each side. Seedless to few seeded. Seeds large, surrounded by a very thick, jelly-like pocket. Said always to be ripened by the lime-water method. Sold in the Canton wholesale markets under the names *Shui Tsz* (水柿) and *Cham T'au* (浸透). Skin and flesh golden yellow. Figure 11.

8. *Sz Man Chuen* (斯文傳)

Reported from Loh Kong Tung (羅崗洞).

Fruits sub-globular to cylindrical in form, round in cross section, the apex sometimes slightly conical. Characterized by a slight constriction just below the calyx, forming a sort of collar. Calyx slightly depressed, calyx lobes sometimes, but not always, reflexed. Skin red-orange in color when the fruit is ripe; flesh golden yellow.

A rather seedy variety, some fruits having as many as four or five seeds. Seedless fruits are often found, however. Generally speaking, the fruits of this variety must be ripened artificially, which is usually done by the smothering method, in order to remove the astringency. There is one tree near Loh Fung Monastery (羅峯寺), however, whose fruits, when ripened on the tree, are sweet and palatable without further processing. Figure 12.

9. *Taai Paat Sin Tsz* (大八仙柿)

Reported from Pak Shaan, Honam Island (北山,河南).

Fruits oblong-cylindrical to globular, round in cross section, of medium size (about 4 cm. in diameter). Few-seeded to rather seedy. Skin deep orange when ripe, flesh golden yellow. Usually ripened by one of the smothering methods. The season extends from late August to early October. Figure 13.

10. *Sai Paat Sin Tsz* (細八仙柿)

Reported from Pak Shaan, Honam Island (北山.河南).

Fruits medium-small, (3.5 cm. in diameter) sub globose. Calyx slightly cupped, with lobes spreading the width of the fruits. Seedy to few-seeded. Skin deep orange when ripe, flesh golden yellow. Ripened by smothering. Figure 14.

11. Kaau Tsai (膠仔)

Found at Kam Ngau Haang (金牛坑).

A seedling variety with seedy fruits. Used as stock for the grafted varieties. An unusually strong and healthy strain, with smooth, fine-grained bark which, when it peels off, leaves the trunk of the tree light grey. The leaves of this variety are unusually large, (commonly 25 cm. long and 13 cm. wide) ovate, acuminate, both surfaces with a soft, inconspicuous but persistent tomentum.

Fruits slightly elongated, sub-globular in shape. Calyx smooth, covered with a dense, short tomentum which is deciduous above and persistent below; edges rolled. This variety seems to differ from the other varieties here considered, in having 10 to 12 seed cavities instead of eight. Fruits not eaten. Figure 16.

12. Ye Tsz Tsai (野柿仔)

Reported to be spontaneous in northern Kwangtung.

A small, seedy globular fruit. If this is a wild form, it may be the ancestor of some or all of the varieties herein considered. Figure 16.

Species of Diospyros other than *D. Kaki* found in Kwangtung

D. cardiophylla Merr., D. eriantha Champ., D. hainanensis Merr., D. lotus L., D. maclurei Merr., D. morrisiana Hance, and D. sinensis Hemsl.

* * *

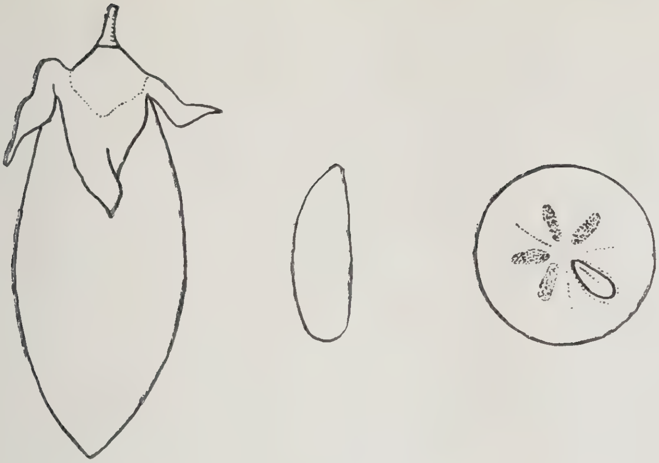

Fig 1 ~ Kai Sam Tsz 雞心柿

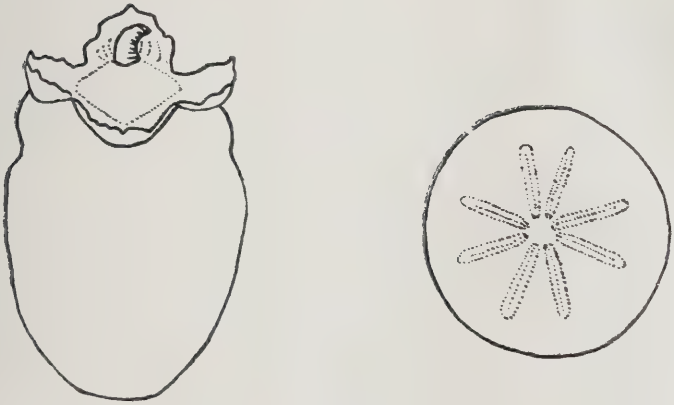

Fig 2 ~ Kai Sam Tsz 雞心柿

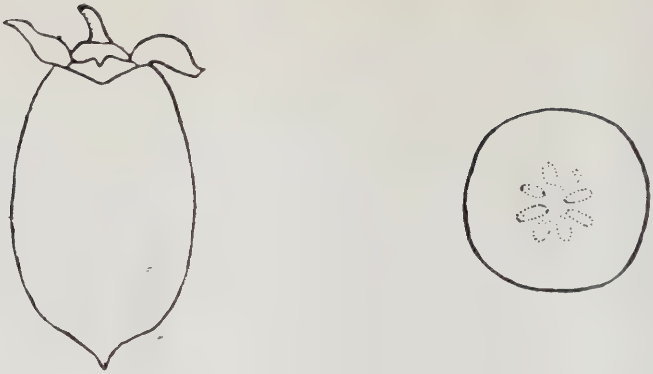

Fig 3 ~ Kwai Fa Tsz 桂花柿

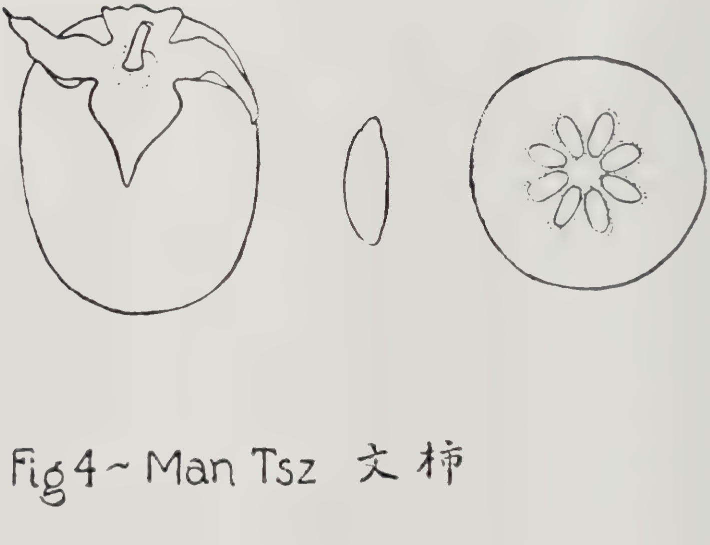

Fig 4 ~ Man Tsz 文柿

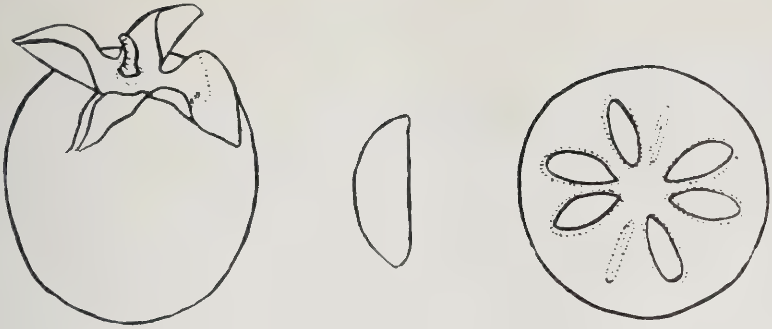

Fig 5 ~ Kai Ngaan Tsz 雞眼柿

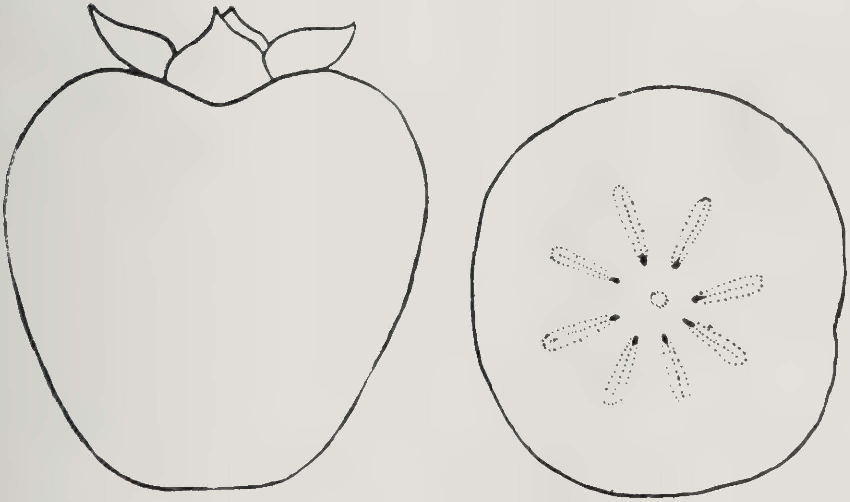

Fig 6 ~ Ngau Sam Tsz 牛心柿

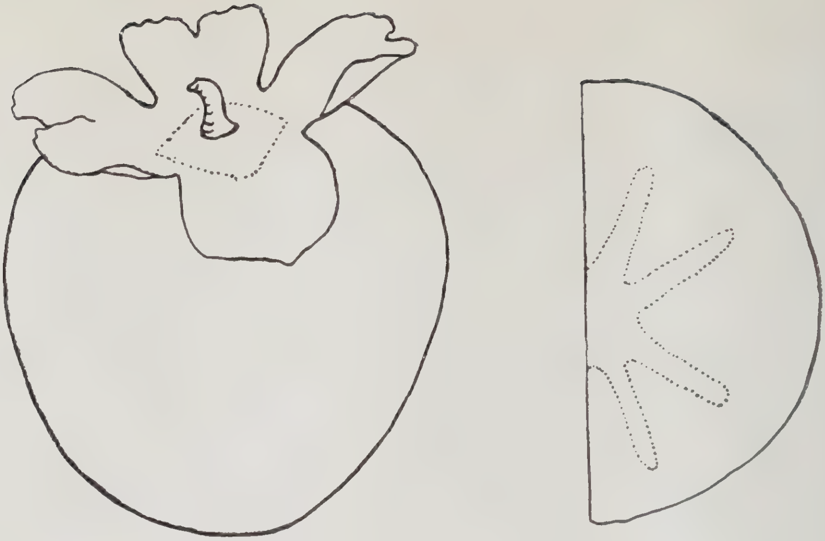

Fig 7 Taai Hung Tsz 大紅柿

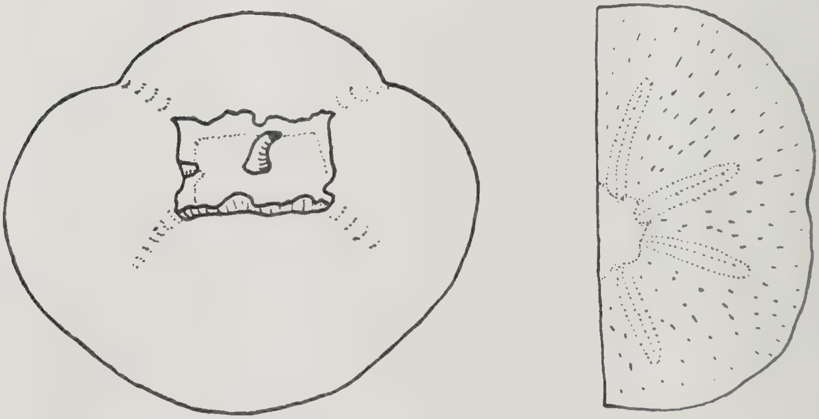

Fig 8~Fong Tsz 方柿

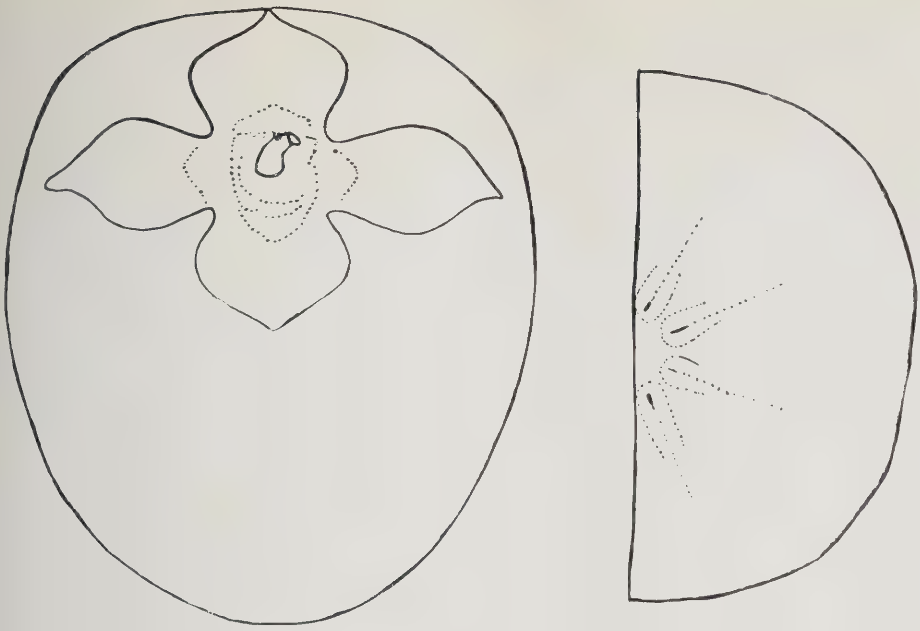

Fig 9 ~ Shai Tsz ~ Tung On Shui Tsz
晒柿　東安水柿

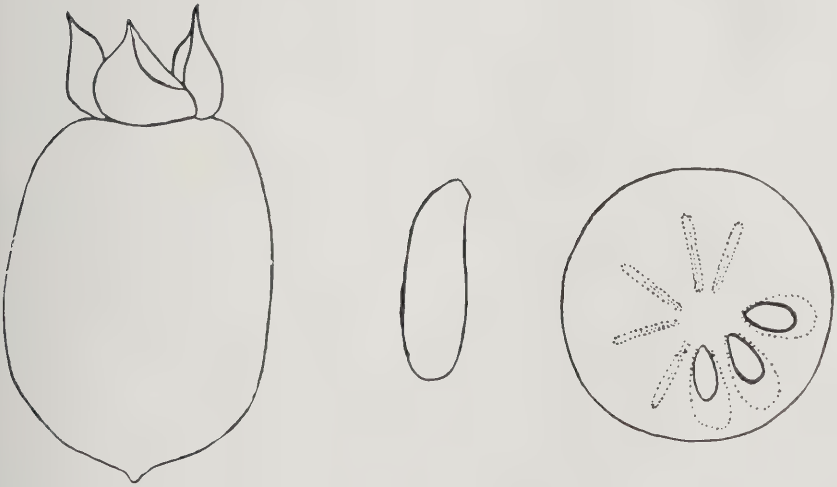

Fig 10 ~ Sha Hok Tsz 沙殼柿

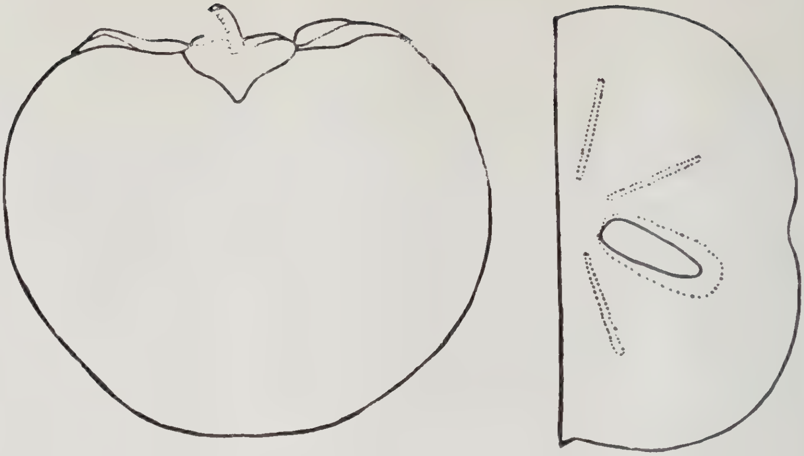

Fig 11 ~ Shui Tsz 水柿

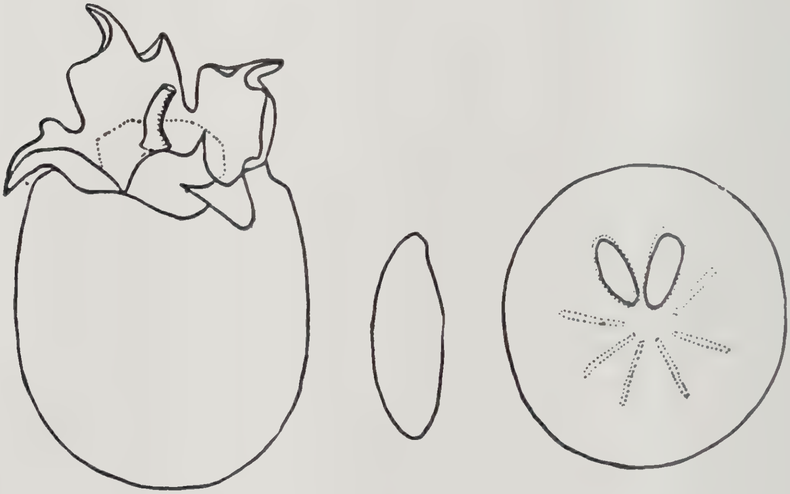

Fig 12 - Sz Man Chuen 斯文傳

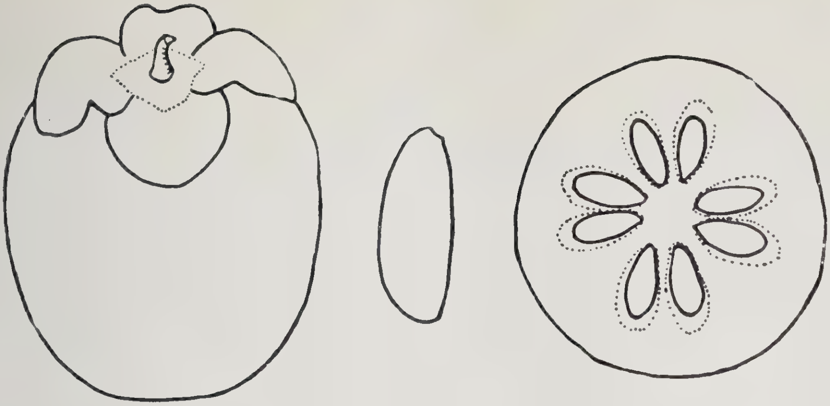

Fig 13 ~ Taai Paat SinTsz 大八仙柿

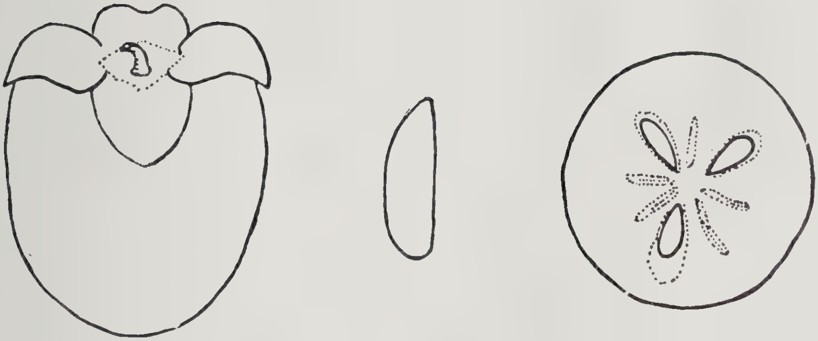

Fig 14 ~ Sai Paat SinTsz 細八仙柿

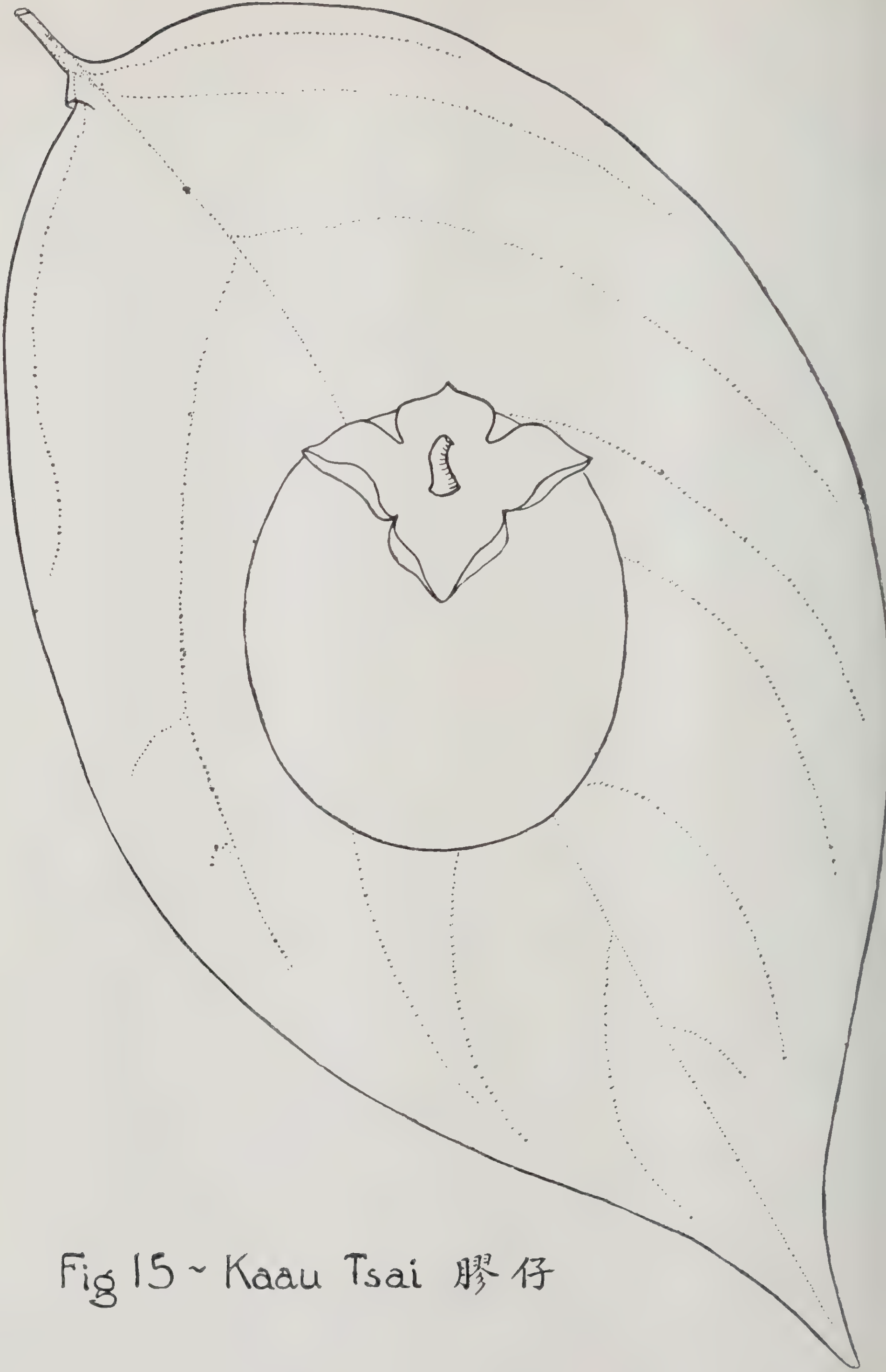

Fig 15 ~ Kaau Tsai 膠仔

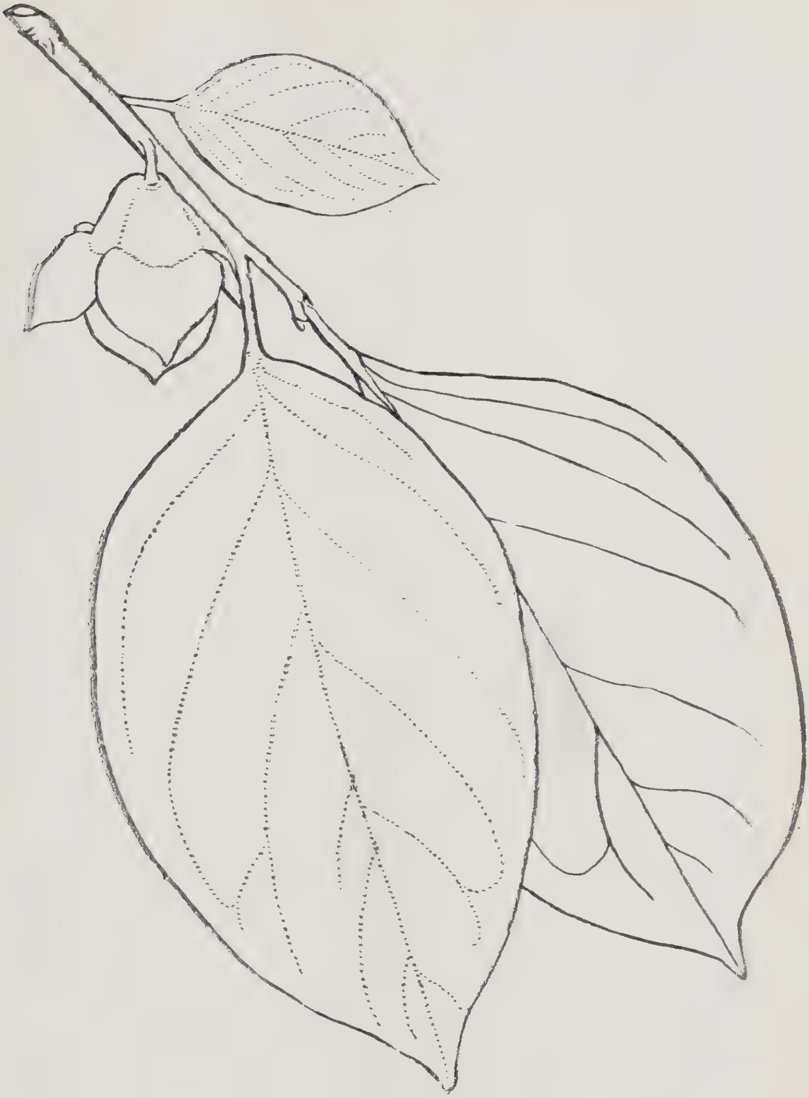

Fig 16 ~ Ye Tsz Tsai 野柿仔

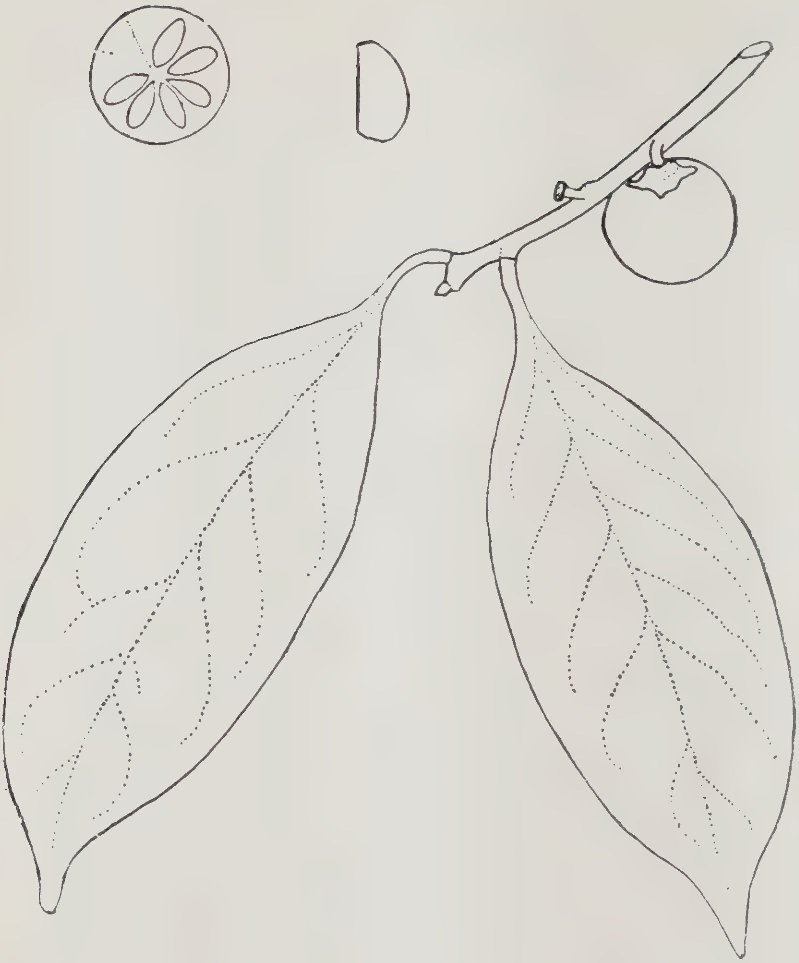

Fig 17 ~ Kaau Tsai 膠仔 Diospyros lotus L

POULTRY FEEDING EXPERIMENTS.[*]

By L. Hoh 何 亮 and Y. T. Kam 甘汝登

Canton Christian College.

In China nearly everybody raises chickens. Very rare indeed is a home without at least a few chickens. Even the boat people, of whom there are some 200,000 within the confines of Canton city alone, do not let the fact that they have a limited space within their small water craft prevent them from keeping a few chickens in a crate which they attach high on the stern of the boat.

While most of the chickens in the Canton region are raised in the village homes in small flocks, there are a number of shops in Canton that make some attempts at commercial feeding. Experiments were undertaken in 1922 and 1923, at Canton Christian College (1) in order to determine the rate of gain in weight of chickens on different combinations of foods, (2) to compare the economy of certain rations, and (3) to find out if possible the most economical length of the feeding period in commercial fattening. These experiments consisted of fattening tests with various available feeds. The birds used were the common market chicken of Canton, which is a small buff colored chicken. This variety is commonly known in the Philippine Islands, where it has been much improved by breeding and selection as the Cantonese chicken.

Feeding Tests Made in 1922

In the experiments conducted in 1922 forty-eight pullets were used in each of two feeding tests extending over a period of 21 days. These birds were brought from the west chicken market of Canton on Lun Hing Street (聯興街). Chickens in this market come mostly from the North River region, which is a region that has a reputation for producing chickens of excellent quality. Those used were about four and one-half months old, and their average weight was a little more than one and two thirds pounds per head at the time of purchase. The price was 49 cents Canton currency[†] a pound.

When the pullets were chosen, careful attention was given to select healthy, vigorous birds, uniform in type and of a conformation that seemed best suited for fattening.

[*] No attempt is made in this paper to describe the common methods of feeding chickens in Canton since this was presented in a paper by W. L. Funkhouser and L. Hoh in Vol. 1. No. 2, pp. 1-6, this publication.

[†] One dollar Canton currency is generally equal to about 50 cents United States currency.

Experimental Feeds Used

The rations used contained rice bran, wheat bran, cooked rice, and ground peanut cake. In each test four different rations were used and fed to four different lots of 12 pullets each. The rations and lots were numbered 1, 2, 3 and 4. The proportions of feeds in each of the four rations are shown in Table I. The amount of experimental feed allowed each lot of 12 pullets was fixed at 3.25 pounds a day.

The cost of feeds per 100 pounds was as follows: rice bran $2.55, wheat bran $3.23, polished rice $4.80 and peanut cake $5.25.

TABLE I.

RATIONS USED

Lot 1	Lot 2	Lot 3	Lot 4
Rice bran only	Rice bran 3 parts, wheat bran 1 part	Rice bran 2 parts, cooked polished rice 1 part	Rice bran 4 parts, cooked polished rice 2 parts, peanut cake 1 part

Supplementary Feeds

Green vegetables, usually cabbage or lettuce leaves, and grit in the form of sand, were given twice a week. Two days of each week each pen had access to ground charcoal for 20 minutes. No records were kept of the amount of green vegetables or charcoal consumed. Drinking water, to which a few drops of potassium permanganate were added was supplied daily.

The pullets, crates, house and equipment were all washed thoroughly in kerosene emulsion before the beginning of each test. Twelve fattening crates with four pullets each were used in each test. Three crates comprised one lot of twelve chickens.

All the pullets were put through a fasting period of twenty-four hours before the beginning of the tests so that the digestive tract would be fairly empty before starting on the experimental rations. They were weighed in lots at the beginning of each test, and every second day thereafter throughout the test. The final weighing was done early in the morning following the 21st day of the period.

Tables II and III show the gains or losses in weight for each lot for each of the two tests. The lots were weighed every other day. Table II is for the first, and Table III for the second test.

Table II shows that the peak of gain for lots 1 and 2 occurred with the weighing on the 14th day. In lot 3 in both tests losses occurred after weighing on the 16th day, while in lot 2 in both tests gains continued until the 18th day after which losses began.

Table III shows no increase in lots 1, 3 and 4 after weighing on the 16th day. With lot 2, gains ceased with the weighing on the 18th day.

The results in each of the four lots are in the same position in both tests and are in the order of lot 4, lot 2, and lot 1. Although the ration consisting of rice bran and cooked rice is shown to be the best of the four rations used in this experiment, the results are far from satisfactory since the gain in twenty-one days was only about 25 per cent of the original weight, while in commercial feedings this percentage would be considered very low for the usual feeding period of 14 days.

The extremely small gains made by all the lots in the first test (see Table II) are probably due to the serious attack of an eye nematode which has been discussed in the Lingnaam Agricultural Review, Vol. 3, No. 1, pp. 15 & 16.

TABLE II.

GAINS IN WEIGHT FOR FIRST TEST

(FIGURES IN POUNDS)

Date of weighing pullets	Lot 1 Total wt.	Lot 2 Total wt.	Lot 3 Total wt.	Lot 4 Total wt.
March 14	19.20	19.10	19.30	19.00
" 16	20.10	20.20	20.50	20.20
" 18	20.30	20.55	20.30	20.35
" 20	19.90	20.20	21.20	20.30
" 22	20.10	20.30	21.00	20.70
" 24	20.00	20.60	21.00	20.70
" 26	20.60	20.70	21.20	20.90
" 28	20.20	20.40	21.50	20.90
" 30	19.19	20.50	21.60	20.80
April 1	19.40	20.50	21.40	20.40
" 3	19.40	20.20	21.20	20.20
" 4	18.90	20.10	21.20	20.20
	Total gain 0.30 Greatest " 1.40	Total gain 1.10 Greatest " 1.60	Total gain 1.90 Greatest " 2.30	Total gain 1.20 Greatest " 1.90

TABLE III.

GAINS IN WEIGHT FOR SECOND TEST

(FIGURES IN POUNDS)

April 9	16.6	16.7	16.6	16.6
,, 11	18.9	19.8	20.1	19.8
,, 13	19.5	20.0	20.1	19.8
,, 15	19.4	20.4	20.1	19.8
,, 17	19.3	20.1	20.1	20.0
,, 19	19.3	20.0	20.1	20.1
,, 21	19.3	19.6	20.1	20.2
,, 23	19.2	19.6	20.7	20.3
,, 25	19.5	19.8	20.7	20.3
,, 27	19.7	19.8	20.8	20.5
,, 29	19.7	19.8	20.8	20.5
,, 30	19.7	19.8	20.9	20.4
	Total gain 3.10	Total gain 3.10	Total gain 4.3	Total gain 3.8
	Greatest " 3.10	Greatest " 3.70	Greatest " 4.3	Greatest " 3.9

Perhaps small gains are characteristic of the Cantonese chickens but it will require further work to confirm this hypothesis. Since the chickens were limited to 2.25 pounds of feed per day in each lot, they may not have had all they could consume every day of the test although in most of the lots, especially after two weeks of feeding, the chickens left some feed in the troughs at each feeding. Lot I in both tests did not eat as much as the other lots, owing no doubt to the fact that rice bran fed by itself alone is unpalatable.

Financial Results from Different Rations

At the close of the tests the chickens were all sold through the Business Division of the Ling Nan Agricultural College of Canton Christian College. For the fowls in the first test the price received was 91 cents and for those in the second it was 96 cents Canton currency per pound.

Table IV shows that losses occurred in lots 1 and 2 in the first test. The results with lots 3 and 4, test 1, and with all the lots in the second test, show slight gains. Ration 3 consisting of rice bran and cooked rice fed to lot 3, was the most economical ration, while ration 1 consisting of rice bran alone, fed to lot 1, not only made the least gains in weight but made them with the greatest cost. The ration consisting of a combination of rice bran and cooked rice, while

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*Labor was figured at five cents an hour and the time required was about one-half hour each day.

TABLE IV.

GAINS IN WEIGHT, COST OF PRODUCTION AND NET LOSS OR GAIN

	Total gain or loss in pounds.	Price per pound received	Cost of feeds consumed	Gain or loss	Labor *	Net gain or loss.
Lot 1 1st test	-0.3	$0.91	$1.34	-$0.150	$0.325	-1.815
2nd ,,	3.1	0.96	1.34	1.630	0.325	0.025
Lot 2 1st ,,	1.1	0.91	1.34	0.553	0.325	-1.112
2nd ,,	3.1	0.96	1.34	1.680	0.325	0.025
Lot 3 1st ,,	1.9	0.91	1.17	0.951	0.325	0.546
2nd ,,	4.3	0.96	1.17	2.329	0.325	0.834
Lot 4 1st ,,	1.2	0.91	1.43	0.501	0.325	1.254
2nd ,,	3.9	0.96	1.43	2.134	0.325	0.379

making the greatest gain at the lowest cost was far from satisfactory since both gains in weight and return were low. In commercial feeding, interest on the investment would also be added to the cost of production and if this were done the net profit from these rations would be still less. This ration has also the widest nutritive ratio and if it were made a little narrower by adding to it some feed like distillers' waste, the results might be more satisfactory.

The losses or small gains in lots 1 and 2 in both tests were very likely on account of the unpalatableness of rice bran. In the latter part of the tests, birds in these two lots were not at all eager for their feed and considerable feed was frequently left in the feeding troughs. At the time the tests were finished the birds in these two lots were very thin. Six of them had extremely weak legs and could not stand up, and all the others of these two lots appeared to be weak and dull, being an indication of improper proportions of nutrients in the ration or lack of sufficient nutrients or vitamines.

Summary of Tests 1 and 2 (1922)

1. Out of the four rations used in the tests, No. 4 which consisted of rice bran 2 parts and cooked rice 1 part by weight, made a gain of 1.90 pounds in test 1 and 4.3 lbs. in test 2 in 21 days, which were the greatest gains in both tests.

2. The ration composed of 4 parts of rice bran and 1 part of wheat bran, and the one consisting only of rice bran were unpalatable and gave the least satisfactory results.

3. There is no doubt a limit to the most economical length of time for crate fattening. In the first test it was reached on the 14th to the 18th day, and in the second test on the 16th to the 18th day of feeding.

4. The relative gains for the different rations are shown in the following table:

TABLE V.

RELATIVE GAINS FOR DIFFERENT RATIONS

	Length of period	Greatest gain during the period		Final gain		Average gain per head	
		1st test	2nd test	1st test	2nd test	1st test	2nd test
Lot I	21 days	1.40	3.1	-0.30	3.1	-0.025	-0.258
Lot II	,, ,,	1.60	3.7	1.10	3.1	0.091	0.308
Lot III	,, ,,	2.30	4.3	1.90	4.3	0.158	0.358
Lot IV	,, ,,	1.90	3.9	1.20	3.8	0.100	0.325

5. In both tests lot 1 was fed at a financial loss. In the second test all lots made a net profit, the greatest gain, $0.834, being made on the ration of rice bran and cooked rice in the proportion of 1 to 2. The gains in the two tests, however, were not satisfactory for if housing, interest and other items were considered the results even in test 2 might show a loss.

6. If the feeding had closed at the end of 16 to 18 days both tests would have given better financial returns.

7. These tests, though unsatisfactory in some details, do show the relative position of the different rations used and suggest the degree of palatability of each, and indicate approximately the number of days for economic fattening.

Feeding Test No. 3 (Conducted in 1923)

Feeding tests were made in the spring of 1923 in order to check the results of tests 1 and 2 made in 1922. Forty-eight pullets were again used and divided into 4 lots of 12 each, care being taken as in previous tests to make the lots as equal as possible in weight, condition and other respects. The rations fed and the procedure throughout was the same as in the previous tests except that at each feeding the feed left in the feed troughs from the previous feeding was removed, air-dried, and deducted from total feed given in calculating feed consumption.

The chickens for this test were purchased at $1.00 and at the end of the test sold for $1.20 a pound. The cost of feeds per 100 pounds was as follows: rice bran $3.00, wheat bran $4.50, polished rice $6.26. These prices were considerably higher, due to the civil war still in progress, than they were when tests 1 and 2 were made.

3. In this test greater gains in weight were made in all lots than resulted in tests 1 and 2. The greater gains were no doubt due to the fact that no trouble with the eye nematode infection was experienced either before or during the test.

TABLE VI.

WEIGHT OF EACH LOT EVERY TWO DAYS

	Lot I	Lot II	Lot III	Lot IV
Days Feeding	Wt. of birds	Wt. of birds	Wt. of birds	Wt. of birds
Initial weighing	22.0	22.2	23.0	22.2
2	23.8	24.0	23.4	24.5
4	23.5	24.4	23.5	25.3
6	24.0	24.3	23.8	25.5
8	24.2	24.5	23.5	26.0
10	24.3	24.7	23.5	26.7
12	24.7	24.8	25.5	26.6
14	24.7	24.8	25.6	26.3
16	24.5	24.4	25.9	26.0
18	24.6	24.5	26.2	26.2
20	24.3	24.0	26.2	26.0
22	23.7	23.2	25.7	25.3

	Total gain	Greatest gain
Lot I	1.7 lbs.	2.7 lbs. (end of 12th day)
Lot II	1.0 „	2.6 „ („ „ „ „)
Lot III	2.7 „	3.2 „ („ „ „ „)
Lot IV	3.1 „	4.5 „ („ „ „ „)

As in tests 1 and 2, it was found that rations 1 and 2, consisting entirely or largely of rice bran, were unpalatable and the birds ate much less and made smaller gains compared with those on rations 3 and 4.

The greatest gain was with lot 4 which received a ration of 4 parts of rice bran, 2 parts cooked polished rice, and one part ground peanut cake, by weight. One chicken in lot 2, four in lot 3, and one in lot 4, for some unaccountable reason, became lame and went off feed during the test. The poor showing of lot 3 as compared with lot 4 in this test was no doubt partly due to this trouble, since this lot was most affected with the lameness.

The greatest gain in this test occurred about the 14th day, after which day lots 1, 2 and 4 lost very rapidly in weight. The chickens in lot 3 continued to gain until the 17th day, when they also began to lose rapidly in weight.

Due largely to feeds being very high priced in 1923, every lot showed a financial loss at the end of 21 days. However, if feeding had stopped on the 14th day every lot would have showed a net profit, ranking in the following order, lots 4, 3, 1, 2. (see table VI).

Table VI indicates that a much greater net profit would have been secured had the birds been sold on the 12th or 14th day, since after the 14th day all lots except No. 3 lost in weight, and No. 3 made no gains after the weighing on the 18th day.

TABLE VII.

TOTAL GAIN IN WEIGHT FOR 21 DAYS, AMOUNT RECEIVED FOR CHICKENS, TOTAL COST, AND NET LOSS

Lots	Total gain in lbs.	Cost of feed consumed	Cost of labor*	Price received per lb.	Value of gain	Net loss	Total grain consumed in pound
Lot 1	1.7	$1.580	$0.131	$1.20	$1.02	$0.691	47.25
Lot 2	1.0	1.758	0.131	1.20	0.60	1.289	47.25
Lot 3	2.7	1.414	0.131	1.20	1.62	0.075	41.00
Lot 4	3.1	1.254	0.131	1.20	1.86	0.475	47.00
Total	8.5	$6.006	$0.524		$5.10	$1.430	182.50

* Labor is figured at five cents an hour and the time required was about one-half hour each day.

Table VIII shows the net profit in case the chickens had been sold on the 14th day. In this table the results show up in the same order with the four lots as in tests 1 and 2. The net profit for lot 4 is much greater than with the other lots, being 245 per cent higher than the net profit in lot 3. Lot 3 gave considerably better results than lots 1 and 2.

TABLE VIII.

NET PROFIT AT END OF 14 DAYS' FEEDING

	Total gain lbs.	Cost of feed consumed	Cost of labor	Price received per pound	Value of gain	Net profit	Total grain consumed in pounds
Lot 1	2.7	$1.05	$0.09	$1.20	$1.62	0.48	31.50
Lot 2	2.6	1.17	0.09	1.20	1.56	0.30	31.50
Lot 3	2.6	0.94	0.09	1.20	1.56	0.62	27.33
Lot 4	4.1	0.84	0.09	1.20	2.46	1.53	31.33

Summary of Test 3

1. Ration 4, consisting of four parts rice bran, two parts cooked polished rice, one part ground peanut cake, gave 245 per cent greater net returns than ration 3 which was second highest in net returns, and which consisted of rice bran two parts and cooked polished rice one part.

2. Ration 3, in which the net returns were next to that of ration 4, would no doubt have given more favorable returns except for a severe attack of lameness in four birds which caused them to go off feed for several days.

3. As in tests 1 and 2 unfavorable results were secured with rice bran only (ration 1), or chiefly will rice bran, (ration 2). In this test the poor returns could not have been due to the unpalatableness of the rice bran and insufficient consumption since the total amount of feed consumed was as great as with lot 4.

4. From the standpoint of economical fattening intensive crate feeding should not continue more than fourteen to sixteen days.

5. The net profits from the various rations when the pullets were purchased at $1.00 Canton currency per pound, fed for fourteen days and sold for $1.20 a pound, with cost of feeds as follows: rice bran $3.00, wheat bran $4.50, polished rice $6.25, on 48 pullets is as follows:

Lot 1, consisting of rice bran only, 48 cents; lot 2, consisting of three parts rice bran and one part wheat bran, 30 cents; lot 3, consisting of rice bran two parts, cooked polished rice, one part, 62 cents; lot 4, consisting of four parts rice bran, two parts cooked polished rice and one part peanut cake, $1.53.

6. If broken rice had been used instead of polished rice the net returns would probably be slightly higher since broken rice is similar in feeding value to polished rice and is about forty per cent cheaper.

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REPORT ON A STEAM FILATURE IN KWANGTUNG.*†

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INTRODUCTION

The silk industry in South China may be divided into two main branches; the production of cocoons from the eggs, and the preparation of raw silk from the cocoons. The former deals primarily with the silk-worm rearing farmers and the egg producers, the latter deals with the filatures. Only the latter will be treated here.

This report is a result of the writers' one month investigation in Shun-tak (順德), the silk center of South China, aiming to reveal all the processes involved in the business. It traces, as detailed and accurately as possible, all the steps beginning with the purchasing of cocoons to the exporting of the finished product. The by-products including the waste silk and the pupae are included in the report. The management and financing, which are of no less importance and interest, are also treated.

The data were obtained from a typical steam-power filature of average capacity. It would have been much better if the writers could have obtained admission into several filatures and secured accurate data on each of them before presenting the report, but there is the handicap that most of the filatures do not welcome strangers to learn their business. The writers, however, succeeded in getting into one which is very representative of the filatures of South China, because of their acquaintance with the managers, one of whom is a stock holder in the filature. Understanding this, it is hoped that the readers may have a better appreciation as to the accuracy of the report.

The name of the filature from which most of the data was obtained is Kung-hang (公享) located in Sui-tang (水藤) Shun-tak District. We gratefully thank the managers, Messrs. Lei Fung Kong and Lei Siu Ching, who gave the writers material aid in obtaining the data.

ORGANIZATION

The organization of the filatures in Kwangtung is complex. Due to the great volume of business every year and the great territory

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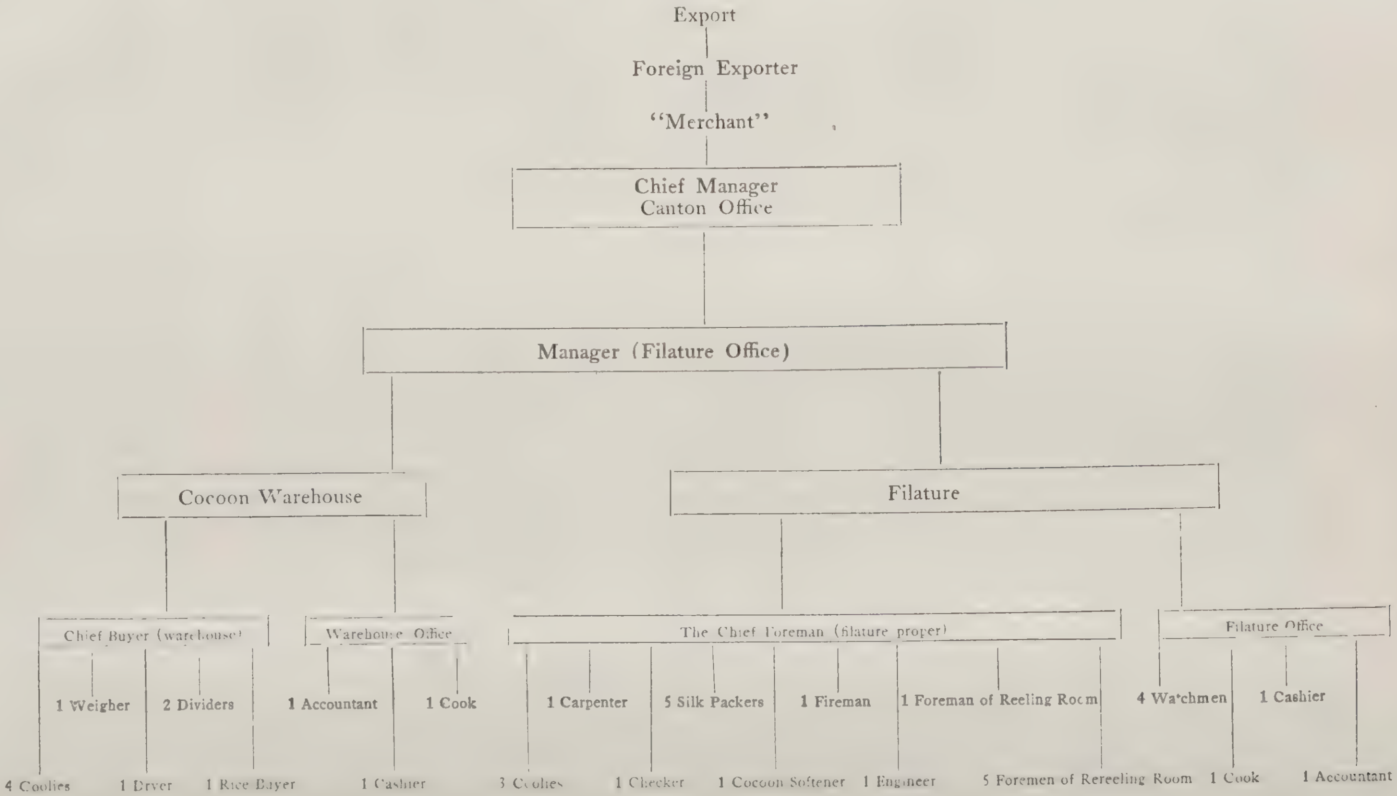
* Contribution No. 1 from the Department of Sericulture.

† A paper submitted as partial fulfillment for credit in farm experience

CHART OF THE ORGANIZATION OF THE FILATURE



of land devoted to the silk industry, the filature people have devised many complicated systems in buying and selling, as well as in management, all of which are very convenient to them.

While some of the filatures are privately owned, most of them are organized on a stock basis, capital being secured by the sale of shares. For systematic presentation of the organization, the writers have prepared a chart in which the details are clearly shown. Explanations of the details will follow the order of the chart.

The Canton Head Office

The Canton head office of every filature is a part of another larger office known as the Silk Commission House (絲莊). An explanation of the latter is necessary.

There are about twenty silk commission houses (絲莊) in Canton, all of which are located in Shaa-kei (沙基). The reason for such a location is nearness to Shameen where all the exported silk is sold to foreign agents. These silk commission houses are organized for the convenience of the filatures and may be privately owned or organized on a stock company basis. Four or five filatures may join together and establish an office. The capital required is about $50,000 which sum may be obtained by assessing it equally among the filatures. The commission house provides a building which is used to accommodate the managers of the filatures and space for temporary storage of the silk as it comes from the country. Silk is sent from the filatures in the country to the commission house in Canton on special boats called "silk boats." The commission house sees that the silk is properly carried from the boat to the house and stored.

Each trip a silk boat may carry as much as half a million dollars of cash or its equivalent in silk. The silk boats are run exclusively for the convenience of the silk business and all of them are self-protected.

Before the silk reaches the commission house, it must go through the Local Tax Office (西稅廠) where it is examined and the tax asessed. The unit upon which to tax is the picul weight. There is no difference of taxation between fine and coarse silks, nor good or poor quality silks, etc. The taxes per picul are as follows:

Canton import tax (from country to Canton)	$1+38%*	$1 38
Fort Tax (once a fort needed repair; money for the repair was secured by a tax on raw silk. Finally it became a permanent tax under the name as such)	$5.105+61%	$8.219
Likin	$6.8025+38%*	$9.393
Total		$18.992

The commission house pays these taxes to the Local Tax Office the next day after the silk arrives at Canton. Besides these, there are two more payments that the commission house has to make for the filature.

Freight to silk boat, per picul		$1.20
Export tax (paid when silk is exported)	$12.679+38%*	$17.498

The above amounts are expressed in Canton currency, the total amount of tax is $37.68 for each picul of silk. The filature pays back this amount to the commission house after the silk is sold.

The commission house furnishes board to all the men living in the house.

To sell the silk, the commission house secures a "merchant", who has had some training in English, to deal with the foreign exporters in Shameen. The "merchant" was formerly paid by a percentage on the silk sold, but this system has been abandoned. He is now hired and is paid a fixed amount per year ranging from $1000 to $2000, depending upon the number and size of filatures forming the commission house. Usually the "merchant" is one of the stock holders of the house.

Each day the "merchant" visits the offices of the foreign exporters who are not always confined to the exporting of raw silk only. Each silk exporting office usually employs a compradore whose duty it is to employ and pay a group of men for testing the silk in the process of buying. The compradore is paid $1.50 from every $1000 worth of goods sold, from which he takes his own salary as well as paying the wages of the men employed in the testing.

The offices of the foreign exporting companies are opened every day between 10:00 A. M. and 3:00 P.M. The "merchant" of the commission houses ascertains whether any orders have been received abroad and whether exporters wish to buy any silk The amount as well as the price offered for each order is noted and reported to the commission house. If the manager of the filature wishes to sell his silk at that price, he instructs the "merchant" to make the sale. The foreign exporter, after testing the silk, pays cash to the seller. The commission house charges the filature $8 to $9 commission on each $1000 worth of silk sold.

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*The taxes are assessed in Haikwan taels but collected in dollars, one Haikwan tael being considered by the tax office as equal to $1.38 Canton money.

The chief manager of each filature, as above stated, lives in the Commission House. Besides seeing that the "merchant" is selling his silk properly, he supervises and finances the filature in the country. He watches the market very carefully and determines which size and quality of silk is to be prepared in the filature, and how many cocoons should be bought in the ware house. Such determinations often mean success or failure to the filature.

The amount of money a steam filature handles in a year is very great. The capital, usually one hundred taels a basin, is a small amount compared with the total which the filature pays out every year. Every crop, of which there are seven a year, a filature will buy $20,000 to $60,000 worth of cocoons. In certain crops when the conditions seem especially favorable to the manager, a filature may buy as much as $100,000 worth of cocoons. Kung-hang, a filature of 504 basins, can consume 1800 to 2000 piculs of cocoons a year, depending on the size of silk produced. If the cocoons were purchased at the low estimate of $2 a catty, it would mean that $360,000 to $400,000 would be needed to buy the cocoons alone. Roughly it takes five catties of cocoons to prepare a catty of silk, 2000 piculs of cocoons would produce 400 piculs of silk. If $340 were required for labor, fuel, rent, etc, to produce a picul of silk, 400 piculs would require $136,000. The total amount of money which the filature would handle in a year would be about $536,000. This gives a general idea as to the needs of a filature, some of the details of which will be discussed again under the cost of production. No fixed figure can be given because the value of the cocoons varies greatly with crop and season.

To secure this great sum of money, the chief manager borrows from the money shops (銀舖), as it is needed. All the money shops are in Canton. It must not be understood that this great sum is needed at one time, or during the entire year; only a part, as it is needed, is borrowed at one time, and returned as soon as there is money available from the sale of the raw silk. The rate of interest is variable, ranging from 8% to 15%, and depending much upon the market conditions. From May to November (Chinese Calendar) the filature borrows fixed date loans. This is due to the fact that a great quantity of cocoons have to be purchased for reeling in the latter part of the year. After this period, the filature borrows for current expenses to pay the wages, board, etc.

All the females employed in the filature, including the reeling and rereeling girls, are paid twice a month. Their wages are computed on the 15th and 30th of every Chinese month and paid on the 20th and 5th of the month, respectively. All the male employees are paid once a month in advance.

In short, the chief manager in the Canton head office supervises and finances the filature; his success depends upon his ability to foresee the market and use the money economically.

THE WAREHOUSE DEPARTMENT

Most of the filatures have one or more warehouses through which to buy cocoons. A big filature may have more than one warehouse, each located in a different part of the silk district. This has a decided advantage in that the price and quality of cocoons may vary in the various silk centers. On the other hand, a small sized filature cannot afford to have a warehouse of its own, so several filatures will combine to own one warehouse. In general, however, each steam filature owns one warehouse.

Practically all the warehouses are located in Yung-kei and Kwai-chow, the two cities being separated from each other by a canal. Formally the cocoon warehouses, found their homes in Taai-leung (大良) a town not very far from Yung-kwai. Owing to the better transportation facilities of the latter, most of the warehouses have moved to that place and only a few are now left in Taai-leung.

There are about one hundred and thirty warehouses in Yung-kwai, the total of which is much increased every year. These warehouses are either located near the river bank or beside the canal. If one should visit Yung-kwai, he could not help seeing the warehouses as they occupy a large portion of the area of the two cities. They are built so near each other that one sees nothing so prominent as the warehouses.

Yung-kwai, the present silk center of Kwangtung, was formerly of little commercial importance. It has become prosperous because the warehouses have centered there, filatures have been established, and many other kinds of business that depend on the warehouses and filatures, have moved to it.

The Construction of the Warehouse

The function of the warehouse is to buy cocoons for its filature. In connection with buying, the warehouse has to dry and bale the cocoons if the latter are to be stored for some time before reeling. These processes take up a great deal of space, and the construction of the warehouse is such as will fit these conditions.

Most of the warehouses, if space permits, are more or less square, being 100 feet square in the larger ones, but less in the smaller ones. They are two story buildings, the ground floor of which is used for buying and baling of the cocoons, while the second floor is used for drying, and temporary storage. Both floors are covered with bamboo matting so that cocoons poured on them will not get dirty. In one corner of the building, on the ground floor, there are several ovens for drying the cocoons. These ovens are built of brick, and are about fifteen feet square. Into them may be put charcoal fires for the heating. Above the charcoal fires are bamboo mats on which cocoons are placed in the process of drying. The temperature is not fixed and cannot be absolutely controlled.

Sources of Buying

Although there are many big cocoon markets in these two cities or towns, the filature warehouse does not buy cocoons there, but only buys in the warehouse. This is primarily due to the fact that buying in the public market is very crude and is simply guessing. The details of the public market will be presented under a separate heading.

Cocoons sold in the warehouse may come from one of the following three sources:

Direct from Farmers.—Farmers who feel that the method of buying in the public market is unreliable, or who are afraid of being cheated by the dishonest men in the market or who have a special grade of cocoons on hand, or who are not willing to pay a comparatively high commission to the market, will find the cocoon warehouse the best place for their product. The warehouse and the farmer may be mutually known, and while the warehouse buys cocoons for its own consumption, no commission will be charged the farmers. Many warehouses, however, do not want to buy cocoons from the farmers directly, as each farmer has but a few bales to sell and this means more work and the cocoons bought are likely to be of mixed grades. The warehouse also has to board the farmers about a day, if they come to sell the cocoons.

Through a Middleman.—The second method of buying is through the middleman, called "Chue-chai-tau" (豬仔頭). The middleman brings the farmers to the warehouse to have their product sold. The farmers themselves are a little afraid of the warehouse buyers, fearing that they may cheat them. They will trust the middleman with their bargains. The warehouse, on the other hand, knows the middleman very well and trusts him to bring more farmers to the warehouse. The middleman receives a commission when a bargain is made; usually it is 0.3 per cent of the value of the cocoons bought from the farmer.

In many filature warehouses, money is loaned to the farmers through the middleman. It must be understood that the warehouse, through the buyer, knows many of these middlemen. Money is loaned to the middleman, and he in turn distributes it among his farmer acquaintances who may be in need of money for buying mulberry leaves, charcoal, etc. The farmers, receiving such aid, will be able to rear their worms to maturity which they could not do otherwise. The middleman makes all the farmers who receive loans from him bring their cocoons to the warehouse. A farmer receiving a loan from a particular warehouee is supposed to give that warehouse the first chance to buy his cocoons. He is willing to sell at a little lower price to the warehouse because he receives aid from it, and moreover, he hopes that the warehouse may give him aid again in the future.

When a bargain is made, the middleman is in a position to effect a compromise between the two parties, not so much for getting the commission if the bargain is made, but mainly to help the warehouse to get cheaper cocoons which means more business through him in the future.

The advantage and disadvantage of making loans to the farmers cannot be overlooked. It is beyond doubt a decided advantage to the farmer as he could not have reared the worms to maturity had he not received aid from such a source. On the other hand, it is also a good means for the warehouse to get more, if not cheaper cocoons. The disadvantage equals the advantage which accounts for the fact that such a practice is restricted to only a few warehouses. When conditions are bad, as during the falling of prices of raw silk or poor harvest, it is not uncommon for the farmers to lose money. If such is the case, the farmer will not dare to bring his cocoons to the warehouse from which he has received aid. Of course, the warehouse will withhold what it has loaned to him if he comes, and consquently the farmer will not have enough cash left for his next crop or even to buy food for the family. He naturally sells his product to some one else and leaves his debts unpaid. Another disadvantage which may be mentioned is that the warehouse has to board the farmers when they come to sell their cocoons.

The amount a warehouse loans out is variable. If it has excess money or if the buyer knows certain middlemen that will help him to get cheaper and better cocoons, it will loan out more. The amount seldom exceeds ten thousand dollars a year however. This sum may be distributed to twenty or thirty middlemen. The farmers who receive the aid are known as "Chue-chai" (猪仔).

From the Speculators.—The third method of buying is from the speculators. They are called "shui-tau" (水斗).* There are many men who make their living by speculating in cocoons. They all buy in the public markets and resell to the warehouses after sorting the cocoons, aiming at realizing a margin. Sometimes they even make bargains with the farmers when the worms have just "ripened" (ready to spin) for so much per rack of cocoons. They have partners among themselves and may work cooperatively.

Most of the warehouses like to get cocoons from such a source because they can be secured in large quantities in a comparatively short time.

The public market is another place for getting cocoons. But this is not used; the warehouse thinks that it is too risky.

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*The Chinese words literally mean "a bucket". It is used as a name for the speculators because the latter try to get a profit by reselling the cocoons, and is comparable to a bucket getting wet when water is poured into it.

There are a few shops that handle cocoons from the North River. Farmers in that region ship cocoons to these shops in bales and trust these shops to sell for them. The shop acts as a commission house and charges a profit of so much per bale. Warehouses often go to this source if the other available sources are exhausted.

Method of Buying

The function of the warehouse, as above stated, is to buy coccons for the filature. The number of men employed in the process has been given in the chart under the warehouse department.

When cocoons are brought to the warehouse for sale, the seller must pour out the contents of each bale on the bamboo matting on the floor and thoroughly mix the cocoons with a wooden shovel. When mixed, the cocoons are put back into the bales and labeled for sampling. There may be many selling at the same time, as is the case in the heavy buying season. To prevent confusion, bamboo checks are used to distinguish the respective bales. These checks are numbered 1, 2, 3, 4, etc, and two kinds of checks bearing such numbers are used. One kind is long while the other is more or less rectangular. The registered number of the bales of cocoons is written on each bale with lime.

All the warehouses follow a similar method of buying cocoons. The method consists of sampling and the price is based on the sample.

To take the sample the buyer or his assistant takes a bamboo basket, with the long check lying on it, and going to the corresponding bales, takes several handfuls of cocoons from the various parts of each bale. These cocoons are subjected to the unwinding test to find out the winding qualities of the cocoons. The reason for so doing needs explanation.

The quality of cocoons as to color, shape and the amount of silk can be more or less readily determined by the appearance or by feeling them, but the winding qualities, which the warehouse must know, cannot be accurately found except by actually reeling them. To do this, the warehouse employs several reeling girls, usually three or four, to carry out the tests Foot power reeling machines are used; these machines differ from those used in the steam power filatures in that the reels of the former are turned by foot treadles. A special room is partitioned off for the purpose. During the heavy buying season, these women have to work all day long. They receive a daily wage of fifty cents each.

A definite procedure is followed in testing the reeling qualities of the cocoons. Out of the basket of cocoons only 150 cocoons are reeled. The rest, about half a catty is not returned to the seller, but belongs to the warehouse.

These 150 cocoons are softened and reeled; the cocoons with the thread broken off will be picked out and put into a basket. After all the cocoons are reeled, the cocoons in the basket are counted. The number is recorded. Then the ends of the cocoons in the basket are found and reeled again. The number broken off is again recorded. The process is repeated once more. The following table gives the reeling quality of one lot of cocoons:

Unwindings	No. of cocoons unwound	No. of cocoons broken off
1st	150	40
2nd	40	13
3rd	13	4

The cocoons that are of good reeling quality will unwind continuously to the end without breaking. But the Cantonese cocoons prepared in the fashion described have at least some breaks. The above table illustrates the reeling quality of a lot of medium grade cocoons. It should be noted that special attention is given to the last two unwindings rather than the first, as the tensile strength of the silk in that part of the cocoon is apt to be weak. If it reels well, the cocoons will yield more silk in proportion to silk waste.

After the girl finishes unwinding the cocoons, she jots down the data obtained. The number of cocoons unsuitable for reeling is also counted and reported. Based on this, the buyer claims that he knows 95% of the reeling qualities of the cocoons.

The next step in the process of buying is to determine the amount of silk in the cocoons. This process is known as "dividing the four taels'' (分四兩). This is the work of the dividers.

After the sample for testing the reeling qualities of a lot of cocoons is taken, another sample for finding the amount of silk in the cocoons is taken. This sample is taken with more care than the former as the price given for the cocoons depends more on this.

To secure the sample, the divider takes a flat-bottomed circular basket about 2½ feet in diameter, and takes about four catties of cocoons from all parts of the bales. The rectangular check bearing the number corresponding to the registered number of the bales of cocoons is put into the basket. Out of these cocoons four taels are weighed, the rest is returned to the seller. The number of cocoons in these four taels is counted, and from which the number of cocoons per catty (16 taels) may be calculated by multiplying by four. Cocoons are generally sold at so much per 10,000 though sometimes at so much per catty.

The number of cocoons in four taels varies from 250 to 400, depending upon the quality and degree of dryness of the cocoons. In counting the cocoons, if there are defective ones, four or five of these are taken as one. Now, if we take for illustration, that there are 354 cocoons in the four taels, the number for a catty is 1,416 cocoons.

The next step in the process of dividing the four taels is to disregard the 54 old cocoons in the 354 cocoons, and ask the seller to take one hundred, of the three hundreds, to represent his cocoons. Of course, the seller will choose the hundred that seems to him to be the best. This he judges by pressing the cocoons with palm and the fingers. The "divider" then takes the hundred cocoons which the seller has chosen and again divides them evenly into five parts each with twenty cocoons. It takes experience and skill to do this accurately and quickly. Each divider has his own method which enables him to do this efficiently. The most common method consists of picking the cocoons in groups of five, from the best to the most inferior, and them a cocoon from each group is taken to form the five groups. When the "divider" thinks that he has sorted the cocoons evenly, he asks the seller to choose the group which will represent his cocoons. The seller chooses the group that he thinks best. This time he is more careful, as these twenty cocoons will be the basis for determining the amount of silk in his cocoons.

When the seller has chosen the group that he thinks best, the buyer or his assistant takes these twenty sample cocoons and removes the pupae. The cocoons are then thoroughly dried over a characoal stove. When perfectly dried, the cocoons are weighed. The weight found is the weight of the twenty dried cocoons minus the pupae.

With the reeling test and this "dividing the four tael" process, the buyer knows the actual amount of silk in the cocoons as well as their reeling qualities.

The price paid for the cocoons, or in other words the value of the cocoons, depends on the selling price of raw silk. The method of estimating deserves mention.

Let us suppose that raw silk is selling at $1500 H K. currency, the currency in which the quotations for Canton silk are expressed; the cost of manufacture for a picul of raw silk is 250 taels (the unit used in the filature for the estimations).

$1500 H.K. (at 1.26 exchange)	$1890 Canton currency.
$1890 L. S. ($1.00=0.72 tael)	1350 taels
Price of a picul of raw silk	1350 taels
Cost of manufacture per picul	250 taels
Balance..............	1100 taels

1100 taels could be invested to buy cocoons to produce a hundred catties of raw silk, or 11 taels for cocoons to produce a catty of raw silk, but the filature would not gain or lose any money from such an investment. To derive a profit, a filature, of course, pays less than 11 taels, unless the price of raw silk is going higher.

It must be recalled that not all the silk in the cocoon is turned into raw silk, some goes into waste. It is estimated for the average cocoons that 25 taels of cocoons (dried and minus pupae) are required to prepare a catty (16 taels) of raw silk, and 9 taels of waste. Based on this, 11 silver taels are necessary to buy 25 taels of cocoons, or 0.44 silver taels for each tael weight of cocoons.

Now, if we take for illustration, that the weight of the average cocoon, in the 20 sample cocoons, is .002 taels, 10,000 of them will weigh 20 taels. At 0.44 taels per tael they would be worth 9.2 silver taels per 10.000 cocoons or 13.927 taels per catty.

To be accurate the cocoons must be thoroughly dried in the oven before weighing. Cocoons have the power of taking up much moisture and the buyer is always very careful about this.

The buying period lasts ten to fifteen days each crop. During the beginning or end of each buying period, a warehouse buys only a few lots a day or a few hundred dollars worth of cocoons a day. But in the heavy buying days, usually five or six days after the commencement of buying, every one in the warehouse seems so much engaged in the buying that he can hardly find time to eat. A warehouse may buy as much as $10,000 worth of cocoons a day.

It is beyond doubt that the buyer is the most important man in the warehouse. He must be so trained that he can estimate accurately the necessary amount of cocoons to prepare a catty of silk, and be so expert that he will never be cheated by the sellers. The "four tael dividers" are his assistants, and they in turn must divide the cocoons evenly.

Drying and Baling of Cocoons

When the warehouse has bought ten or fifteen bales of cocoons, the latter are put into the ovens and dried with charcoal fires. The degree to which the cocoons should be dried depends on the length of time the cocoons are to be stored. If cocoons are to be stored for more than three months, they should be as dry as possible. Cocoons pressed and stored should be absolutely dry.

If cocoons are insufficiently dried, or stored in a damp place the pupae will ferment, and a brownish yellow fluid, the result of fermentation, will render the silk useless. Such cocoons can be pulled apart easily. They are known as "Ai-ngon-kaan" (挨甄繭) and cannot be reeled.

The Cocoon Market in Yung-Kwai

All of the markets are situated near the river bank. Their construction is simple. The front part is an empty hall for the farmers to display their cocoons at marketing time; the back part is divided into many small pens for the "shui-tau" to keep their cocoons temporarily. At both corners of the front there is a weighing place, and at the left corner an office.

The markets are owned by companies and operated on a commission basis. They employ two groups of men: one group takes charge of the market and attends to such work as weighing, recording, accounting and paying out cash; the other takes charge of the launches and boats which the market rents for transporting cocoons from the country.

The function of the market is to provide a suitable place for marketing large quantities of cocoons in a short period of time and to buy, indirectly, cocoons for the cocoon warehouses. The market pays the money to the farmers immediately after a bargain is made but receives the money from the "shui-tau" after the latter has disposed of the cocoons to the warehouse. The market realizes its profit in the following ways: (as the following data were obtained from a buyer, its accuracy should be verified by further investigation)

1. The market collects 1.5% of the gross price from both the seller and the buyer as commission.

2. The market pays 98.6% of the gross price to the farmer, (this percentage varies with the interest on money at the market time) but receives 99.8% from the "shui-tau".

3. The market adds 0.3% of the gross price and this amount is charged to the "shui-tau".

4. For every 100 taels of cocoons marketed, 2 taels are deducted for taxes to be paid to the government.

It should be mentioned that the above data are not absolutely reliable because the information obtained from different persons varies a great deal. The writers, however, have actually copied from the green papers on which the actual deduction by the market can be figured out:

	(1)	(2)
Net weight of cocoons	53.5 taels	85 catties
Price per catty	.95 taels	1.47 taels
Sale price	50.82 taels	124.95 taels
Deducted for commission, etc,	2.465 taels	5.94 taels
Net	48.335 taels	118.91 taels
Percentage of deduction	4.8%	4.8%

From the above calculation it is evident that from every 100 taels of cocoons sold, the market deducts 4.8 taels; the farmer receives 95.2 taels as the net price.

There are seven crops in the year, for each crop the market opens about fifteen days and buys from 300,000 to 500,000 taels worth of cocoons.

During recent years the competition between the markets has been very keen. In order to have more business the markets send out launches and boats to the country to transport the cocoons to the market for the farmers free of charge, and in addition thirty to forty cents is paid to the farmer for each bale of cocoons sold in the market. Each bale of cocoons weighs about 10 catties only.

A few days before the market opens, notices are posted in the country, informing the farmers when the launches will come to transport cocoons. One launch tugs about ten boats and arrives at the market at about 7:00 A.M. The farmers then carry their cocoons to the market and the speculators, or "shui-tau", come and examine the cocoons and bargain with the farmers.

The ways in which the "shui-tau" determines the price of the cocoons are as follows:

1. To know the general conditions of the crop. The "shui-tau" should know the rearing conditions of the locality from which the lot of cocoons comes, especially the weather conditions at spinning time. If the weather is warm and fine at spinning time the cocoons will have good continuous fibers, and vice versa. Generally the weather condition of the second crop is mostly unfavorable while that of the sixth crop is the best.

2. The pulling test. To test the quality of the fiber of the cocoon the "shui-tau" takes a sample cocoon in his mouth and chews it for one or two minutes in order to thoroughly soften the gum with the saliva. He then holds one end of the cocoon with his teeth and pulls the other end with his hand to the length of about one foot. If the cocoon is good the fibers will continue unbroken, forming a beautiful continuous layer. With bad cocoons many of the fibers will break when being pulled to the length of one foot.

3. To determine the thickness and uniformity of the cocoon. The next thing for the "shui-tau" to do is to take a handful of cocoons at random from the package, feel their thickness by pressing them between his fingers, and find out the proportion of poor cocoons. They prefer small, compact and more or less pointed cocoons, to the large loose ones. Uniformity of grade is greatly emphasized.

4. To determine the moisture content of cocoons. In the market cocoons are sold by weight. Since the water absorbing power of the cocoons is very great the degree of dryness is an important factor in determining the price. The "shui-tau" determines the moisture content simply by feeling the cocoons with his hands.

Although the process is described at some length, it takes only a few minutes for an experienced "shui-tau" to determine the quality of a lot of cocoons and fix the price. There are several hundred speculators in the market. A number of them may form a group and buy cooperatively. Each member of the group will come along and offer a lower price than the previous one, in an attempt to compel the farmer to sell at a low price. But an experienced farmer knows their tricks. When a bargain is made the lot of cocoons is immediately weighed. The scales used in the market are usually about three per cent incorrect.

When a buyer or a "shui-tau" comes to the market he must first register in the office. He is then given a registration card, on the outside of which is written his name. After each lot of cocoons is weighed the buyer hands in his card for recording the weight. The farmer, on the other hand, receives a check on which is printed a large number, the date, the name of the market and the statement that the money must be drawn within ten days after selling. The detailed data are recorded by the market in the following way: inside the office there are three recording clerks; one records the weight and price on a green paper, another records on a red paper, while the third records the same, with the name of the buyer or "shui-tau", in a book. The red and green papers are then turned in to the accountant who figures out the gross and net prices of the lot of cocoons. The green paper is then turned in to the cashier who will prepare the money which, together with the green paper, is given to the farmer. The red paper is kept for the buyer when closing the account with him. The data on the books are retained by the market itself.

After weighing, the cocoons are poured out on the matting in one of the pens, where several women are employed to pick out the very poor and discolored cocoons, before sending the consignment to the warehouse. The farmer then takes the empty bales to another weighing place, next to the place where he weighed the cocoons at first, and has them weighed. The weight is recorded on the check and a stamp is put on it. At the same time the recorders in the office make the same record. After this the farmer may draw the money immediately if he wishes to do so. The market closes about 12:00 noon.

THE FILATURE DEPARTMENT

There are one hundred and sixty seven steam-power filatures in South China, most of which are located in the silk centers of Shuntak. Kung-hang, the filature which the writers investigated, is located at Sui-tang (水藤), a town in Shuntak. There are thirteen filatures in this place, Kung-hang being one of the prominent ones.

Most of the filatures in Sui-tang are built by the clans. Each clan builds one or sometimes two filatures and rents them out, usually at the rate of ten per cent of the investment. The clans take great interest and pride in seeing that every girl or woman bearing their surname finds work, and is accumulating wealth. Many clans have become prosperous because of the filatures in their vicinity.

The cost of building a filature varies in different places. To build a filature of 500 basins about $60,000 is required.

The construction of all of the filatures is very similar. A detailed description of Kung-hang will be given.

The arrangement of rooms is also very similar in all the filatures. The area under roof is about three Chinese mow. This includes an office building, the cocoon storage and softening building, the reeling and rereeling buildings, and the engine and cocoon distributing rooms. Each building or room, together with the work carried out in it, will be discussed under a separate heading.

The Office Building

The office building has two stories. The ground floor is used as a reception room. There is a little room known as the Cheung Fong (帳房) on the ground floor in which all the money and record books are kept. The second floor is used for bedrooms for the men employed in the filature. There is nothing in this building which deserves special mention.

The Storing and Softening of Cocoons

The Storing and Softening Building.—This is a three story building tightly constructed of brick, with a few small windows in the wall. The second and third floors are used mainly for storing cocoons; while the ground floor, being kept dark and damp, is used solely for softening cocoons for reeling.

The Storing of Cocoons.—Cocoons bought for future consumption, when the price is low, or for winter reeling, are tightly pressed and packed in cloth wrapped bales. Those for immediate use are loosely packed in mat packages without pressing. With proper handling the pressed cocoons may be stored for five to six months without much damage; while improper storage will cause the cocoons to become moldy, the pupae to decay, and consequently greatly depreciate the value of the cocoons. It is said that even with proper care in storage, the pressed cocoons usually give rise to more broken ends in the cocoons, and hence require comparatively more cocoons to finish a catty of silk.

The Softening of Cocoons

The process of softening cocoons is the first important step in preparing cocoons for reeling. Its success or failure exerts a vital influence upon the reeling process. If softening is properly done, subsequent soaking in the hot water basin will dissolve the gum in the right amount of time. The cocoons will then be smoothly unwound; there will be fewer breaks of the threads, and less waste of silk. On the other hand, if the cocoons are over or under softened, subsequent soaking cannot dissolve the gum in the proper amount of time, and the following troubles will occur: under softening will cause the cocoons to jump in the reeling process because the threads, unwound from the cocoons, have not had the gum thoroughly dissolved; over softening will make the cocoons too heavy with moisture, hence they will soon sink to the bottom of the basin. Either will increase the difficulty of reeling, and give rise to frequent breaks of the thread as well as much more waste of silk.

The softening process is an art. Its success depends much upon the skill and judgment of the softener. He must take into consideration a number of factors. Cocoons stored for future use have at least been partially softened through the long periods of storage, hence either no treatment or only a little softening is necessary.

Green cocoons, or cocoons just off the spinning racks without stifling, may be reeled at once without softening, and generally give better results, but this is rarely done in Kwangtung.

Slightly stifled cocoons may be softened by keeping them loosely in mat packages for several days. The room in which the packages are kept should be cold and damp.

Stifled cocoons should go through the following processes, which are modified according to the crop in which they were produced, the season of the year, and the temperature and humidity of the day.

During the first, second, and third crops, when the moist south wind is prevalent, the process takes only one or two days. Hot water is poured upon the tile floor once a day to make it wet (if the weather is sufficiently damp this step may be omitted.) Hot water is used instead of cold because the former evaporates more quickly, and the vapor thus liberated is therefore more readily absorbed by the cocoons. The heat generated from the hot water also helps somewhat in softening. The cocoons are then evenly spread on the tile floor, one foot deep, and thoroughly mixed with a wooden shovel twice a day. After about two days they are piled up into a heap to be warmed a little for about twelve hours. The heat is generated from the fermentation of the pupae. They are transferred to mat packages in which the warming process continues for another twelve hours, and are then ready for use.

During the fourth, fifth, sixth, and seventh crops, and especially the last three, when the dry north winds are prevalent, the process takes a much longer time, and is somewhat modified. The spreading and mixing process takes three to four days, the piling up process takes two days and the warming process in the mat packages takes another two days. In addition, hot water is poured upon the ground as well as on the cocoons, which are then covered with wet mats to prevent rapid evaporation.

When a heap of cocoons is properly softened, it will feel slightly warm and moist to a trained hand, and fairly soft when a handful of them is pressed with the fingers. The "burning smell" which is very characteristic of the dried cocoons is greatly reduced. The pupae inside also become somewhat soft as compared with the brittle, hard ones in the dry cocoons.

The Reeling Room and the Reeling of Cocoons

The reeling of cocoons plays the principal role in the filature. It consists of unwinding the cocoons into skeins of silk suitable for weaving. In practically all the filatures there is a provision for a rereeling room in which the skeins are rereeled into the size to fit the American reels. Silk exported to France is not rereeled. As this is the principal part of a filature, the data regarding reeling will be presented under sub-headings.

Construction of the Reeling Room.—This room, occupying half of the space of the plant, is built of brick and tile. The floor is covered with square tile which gives a dry surface all the time. The roof is built of tile supported on brick columns at twenty feet intervals each way.

Kung-hang, built a few months ago, is somewhat better in construction, in certain respects, than the older ones. There is a better provision for light and ventilation. In the older types the roof is very low; the walls are tight with only small windows on the side. In Kung-hang there are big ventilators on the roof, and wooden shutters between the brick columns on the side. The steam from the basins can be carried away through the ventilators on the roof, and light and fresh air can be admitted from the side. In spite of this, the room is very hot in the summer time.

The main entrance divides the room into two parts. Each half has eight rows of basins known in their terminology as "boats" (船). Between the "boats" are narrow paths through which the foremen walk in supervising the work of the reelers.

The Equipment.—Practically all the equipment used in the filature is made locally. With the exception of certain articles, such as belts and measuring devices, the rest are manufactured either in Shun-tak or in or near Canton.

Power is secured from coal, a steam engine being used. The boiler is made in Honaam (河南), located on the south side of the Pearl River from Canton. The cost of building a boiler which will give enough steam to propel a 500 basin filature is $7,000. Two and a half tons of coal are required daily. The steam generated from the boiler is piped to the engine. The pipes are not covered and no doubt there is a great deal of heat lost by radiation.

The engine is made in Lok-chung (樂 從), a town in Shun-tak. A water pump is attached to the engine on the other side of the fly wheel. The fly wheel is six feet in diameter. The cost of the engine is $1,300 to $1,400; the cost of the pump is $170. Power is transmitted to the other parts of the plant by means of belts and steam pipes.

The reeling equipment is made of wood and bamboo. Much of the timber is imported but the bamboo is grown locally.

Each girl occupies about two feet by six feet, or twelve square feet of space.

When a new filature is built, after the roof is completed, about twenty or thirty carpenters are hired to make the reeling equipment. With such a company of men it takes more than three months to finish making the reeling equipment. The cost of wood and labor to build a basin is $7.00. In practice, the builder makes a contract with certain experts to have it done for him. Such a practice has been found more economical.

Each "boat" has two parts to it, the front and the rear, between which the reeling girls sit. The hemispherical basin is made of clay one foot four inches in diameter and six inches deep. Into it is placed a circular metallic plate through which the steam pipe conducts the steam. Such an arrangement enables the heat from the steam to be evenly distributed in the basin. If the water in the basin is too hot, it may be regulated by opening a cold water faucet which is located in front of the reeling girl.

The hind part of the "boat" contains the reels on which the silk is to be wound. Formerly, these hind reels were turned by the foot, and the filature using such was called a foot-power filature. There are about seventy such filatures in existence in Yung-kwai. Products from such filatures are mostly used for local consumption though they may occasionally be exported. The steam-power filatures differ from the foot-power ones, in having the hind reels turned by a belt connected with the engine, and the speed is more uniform and more easily controlled.

There are three types of reels used in the steam power filatures. The French reel from which the silk is not rereeled, has a circumference of 80 inches. All the silk exported to America is rereeled. In this case the first reel has four sides; the circumference is 26 inches; the rereel has six sides, with a circumference of 56 inches. All the reels are made of hard wood and are very durable. Except for the smallest one, the circumference of each reel can be adjusted.

Aside from the equipment mentioned above, there is a denier testing machine (sizing reel). The reel of this machine is six sided and has a circumference of 46 inches. To test the denier of a skein of silk in question, the tester winds the silk on the reel, turning it 400 revolutions. The sample skein is dried and weighed. A special Chinese scale (厘等) is used, the latter is accurate to two tenths of a denier.

Method of Reeling.—The *Chambon* system of reeling is used in all the filatures in South China. This method is an older one than the *Tavelle* system. It is claimed that the latter can not be used on the soft and fine Canton Silk, and only the former method can be used, but such a statement has not been experimentally proven, it is only a theory. We are in great need of experiments from which conclusions can be drawn.

With the *Chambon* system, the reeling girl can manage two ends at one time.

The cocoon, as the worm spins it, consists of three layers of silk much different in quality and structure. The first layer is called the floss and is irregular in structure and is loosely attached to the cocoon. Then comes the second layer which is the good silk. The fibers of the third layer are flattened and the whole layer looks papery. Envoloped in the third layer is the pupa. Only the middle layer should be unwound to form the skein silk. The rest goes to form waste products of the industry and will be treated under waste silk pupae respectively.

In the reeling of the cocoons, the girl first puts several handfulls of cocoons into the basin and subjects them to a boiling temperature for five to ten minutes. Then she takes a brush made of twigs and beats the cocoons. The floss, being soft and loose, is caught by the brush and part of it is removed with the latter. About two taels of cocoons is softened at one time; if more than this amount is put into the basin, the girl will receive a fine of five cents each time. The reason for such a fine is that cocoons will absorb more water than they should if boiled too long and consquently will sink to the bottom of the basin. Sunken cocoons make reeling difficult. Usually the reeling girl will reject all sunken cocoons because they break too often. The second reason is that the fibers of the cocoons will loose their tensile strength if boiled too long. The water is not clean since dirt and parts of the pupae may be dissolved in it. Such water may have a harmful effect upon the silk.

The brush cannot remove all the floss. The girl next takes a pair of chopsticks and stirs the cocoons again. This operation enables her to remove the remaining floss as well as to find the ends of the cocoons. To make a thread, the size of which depends on the denier of silk to be prepared, fibers of several cocoons have to be used.

The following table gives the number of cocoons used to prepare silk of various deniers:

Deniers	No. of new Cocoons *	No. of half-reeled cocoons *
14/16	7	8
13/15	6	7
20/22	11	12

The above table, giving the number of cocoons required to prepare silk of various sizes, is only approximate. Cocoons of various crops have fibers of slightly different sizes. The following table gives the number of deniers of each cocoon fiber of each crop of the year.

No. of the crop	Average deniers of the cocoon fiber
1	2.2
2	1.8
3	1.9
4	1.9
5	1.95
6	2.00
7	1.85
8	1.80

The minimum denier of the Canton cocoon is 1.75; the maximum is 2.4. The above table is also a rough guide for the filatures in the determination of how many cocoons should be used to prepare a thread of a certain denier. Quality of cocoons is greatly influenced by weather and mulberry leaves, and care given to the worms. For this reason, the filature tests the size of their cocoon fiber before reeling.

To test the size of the fiber of a new lot of cocoons, the tester uses the sizing machine. A sample of the cocoons is taken and subjected to the same processes as if for reeling. Every filature has one or two girls who are specially trained to carry out the test with the tester. Only with especially trained girls can the test be carried out smoothly and accurately.

The threads, instead of going to the hind reel, are wound onto the machine. To be accurate, it is very essential that the girl keep a fixed number of cocoons to a thread all the time. In practice six cocoons are unwound for a thread. The tester turns the denier machine slowly at a rate just fast enough to unwind the cocoons smoothly. The girl throws in new cocoons as soon as those being reeled become a little translucent. This step is most important; for the translucent cocoons must be immediately replaced by new cocoons. The result

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* The fiber of a cocoon gets thinner toward the inner layers. In practice, the filature calculates that silk other than from the first part of the middle layer has .4 denier less.

found is the denier of the new cocoons only. Four hundred revolutions of the machine prepare two sample skeins, each from six cocoons. To insure greater accuracy, the tester repeats the above process and gets two more skeins, making a total of four sample skeins. These skeins are then dried near the engine and weighed. For illustration let us say that these four skeins weigh 48 deniers. As each skein is prepared by unwinding six cocoons all the time, four skeins would be from 24 cocoons. This meams that each cocoon has a fiber which averages two deniers.

Based on each cocoon having a fiber of two deniers, a 14/16 denier silk would require 7½ of these cocoons. It must be recalled, however, that only the outer middle layer of each cocoon is unwound throughout the test. To compensate for this, it is the practice to assume that silk, other than from this part of the cocoon, has a size of 0.4 denier less. The conclusion from the above test would be:

$$\text{14/16 silk use} \left\{ \begin{array}{l} \text{4 new cocoons..(4} \times \text{2 deniers) ....8} \\ \text{4 half-reeled...(4} \times \text{2, minus 0.4 D.)..6.4} \end{array} \right\} \text{Total ..14.4 Deniers}$$

The total 14.4 deniers is from four new cocoons and four half-reeled cocoons. It is the nearest to 14/16 silk one can get, based on each new cocoon having two deniers. If at the beginning, only new cocoons with a fiber of two deniers, as tested, are available, the reeling girl would use seven cocoons to start the reeling. In practice, seven cocoons would be recommended instead of eight because they think that under size is better than over size.

When the number of cocoons for preparing a certain size of silk has been determined, there is posted a notice to inform every girl that a certain number of new cocoons and of half-reeled cocoons should be used. The reeling girls should follow this strictly as the size of the silk depends upon it.

Having discussed the way to determine the number of cocoons which should be used to make up the thread, let us continue with the method of reeling. Each of the two threads first passes through a hole in a button and then passes to a hook above. Before going up to the hooks above, however, the two threads are twisted around each other. Twisting is very essential; it gives cohesion and tensile strength to the threads. The device for twisting consists of an arrangement of gears and wheels which gives 200 twists when its handle is turned once. A bell rings when the handle has made one turn. After the threads pass over the hooks, they are again twisted, and pass to the reel to be wound into skeins. The reeling girl has to very carefully watch the cocoons that are unwinding. She must maintain the same number of cocoons to a thread all the time. To do this, she uses her left hand to hold the ends of the cocoon fibers, and uses her right hand, with the aid of the chopsticks, to throw the fibers of the cocoons into the thread. Defects of raw silk mostly come from an improper method of reeling or are simply due to carelessness of the reeling girl, and will be taken up under the defects of raw silk.

System of Checking.—It is very necessary that there should be a system for checking every woman's work. If even one or two dozen out of a few hundred workers are dishonest or careless, which is very often the case, it will mean a large loss to the filature. Silk, unlike other bulky products, is very expensive and is easily stolen, while its quality is easily lowered by a few individuals producing defective silk all the time. If these girls cannot be detected and properly taken care of, it will be fatal to the filature.

The filatures in South China have a very simple, inexpensive, and yet efficient way of checking every woman's work, the origin of which the writers have not been able to find.

Each "boat'' is given a Chinese character and the characters generally used are 天 地 玄 黃. In Kung-hang the "boats'' have 30 and 33 basins respectively. The basins of each "boat ' are numbered 1, 2, 3, 4, 5, etc. under the Chinese character of the "boat''. These numbers are written on the basin, and the girl using that basin is called the same. Four large bamboo checks and four small ones are provided for each basin. These checks are numbered the same as the basin. The four large ones are hung on the upper beam of each basin while the four small ones are given to the checker. The latter has a table of his own which is located near the cocoon distributing room. With these eight bamboo checks for each basin, four large and four small, it is possible to check every woman's work in the filature. Before going further, it is necessary to explain the functions of the cocoon distribution room which plays a large part in checking.

In preparing raw silk for export, it is required that every "book'' of raw silk should weigh eight catties and contain about the same number of skeins. The foreign exporter will refuse to buy if there are too many or too few skeins to each "book''. For coarse silk (20/22) a "book'' should have 55 to 56 skeins; for fine silk (14/16) a "book'' should have 60 to 61 skeins. Silk sent to France (13/15) has no such requirement as to the number of skeins to a "book''. Let us recall that the girl reels two threads at one time, these two skeins are formed on the reel. Later these two skeins are rereeled into one single skein, twisted, packed into bales and exported, so this skein, in order to be just right, must weigh 1/55 to 1/56 (for 20/22) etc. of a book. The function of the cocoon distribution room is, therefore, to furnish a place where the cocoons are weighed and divided into separate baskets sufficient to produce a skein of silk of the desired weight. The amount of cocoons in each basket varies from twelve to fourteen taels, depending on its quality.

Another advantage of giving a fixed quantity of cocoons to each woman, which is done in the cocoon distribution room, is to test the efficiency of each reeling girl. This will be referred to later.

Let us go on with the system of checking. When the reeling girl wants cocoons, she gives one of the big bamboo checks to the checker. The latter receives the big check and gives back a corresponding small one to the girl. With this small check, the reeling girl can get a basket of cocoons which has been previously weighed out for her. The checker, on the other hand records on a printed sheet that that basin has taken a basket of cocoons. This is done by putting a red mark on the number of that basin, on the printed sheet. When the girl finishes reeling the basket of cocoons, she attaches the small check to the reel on which the two skeins are wound; the reel, with the check attached, is returned to the checker. The latter, seeing that the basket of cocoons previously sent out is reeled and not stolen, puts a cross mark on the previously made red mark, specifying that the basket of cocoons has been reeled.

The girl, in turn, takes another large bamboo check, of which she has four, and exchanges for another basket of cocoons. Most of the filatures have women specially provided for doing this for the reeling girls, so that the latter need not run around in the filature and waste time. The women employed for such purpose are called "Tei-sha-po" in the local dialect (地沙婆).

The checking system does not end here. After the reel with the check on it is handed to the checker, the reel is brought to the room in which the silk is rereeled. The silk to France is not rereeled and the check will remain with the skein until packed. After rereeling, the rereeling girl transfers the checks from the small reels to the skeins reeled from them. The rereel reels four skeins of silk at one time. When the four skeins in the rereel are finished, the rereeling girl puts one of her checks, of which she has four for each rereel, on the rereel. This fifth check, different from the rest, checks the rereeling girl's work.

After the silk is rereeled, the skeins are dried on the reel. After drying, the silk twister takes the skeins off the reel and weighs each skein separately. The weight of each skein is recorded in the following way. There is a box specially made for this purpose. There are many compartments to the box, and on each compartment, there is written a weight. The weights range from 1.5 taels to as many taels as the weights of the skeins will vary. The twister, after weighing a skein, puts the attached check into the compartment corresponding to the weight of the skein. By reference to the checks in the compartments, the checker can get the weight of each skein which is recorded after the day's work is over. It must be understood that each skein is from the same quantity and quality of cocoons and should be very much alike in quality and quantity. The difference in weight of a skein from the average shows the ability of each reeler. If anything is wrong with the rereeler, she can be checked by the fifth check attached to the rereel.

To prevent mixing of one day's work with another day's, the filature provides three sets of small checks. Each set has a color of its own, and the sets are used alternately, one set each day.

This system enables the filature to check every woman's work until the silk is packed.

Having considered the general sub-headings of the reeling of cocoons, let us consider the work of the different individuals separately.

The Reeling Girls.—Most of the reeling girls, as well as the re-reeling girls, live in their homes. In many filatures there is a dormitory provided for the girls who come from other parts of the district.

The dormitory is two stories and is large enough to accommodate about 200 women. There are twenty-eight rooms, eight persons to a room. The filature provides all the fuel they burn; there is no charge for rent.

Work begins at half past six every morning and stops at the same hour in the evening. They work seven days a week. From 9:30 A.M. to 10:30 A.M. there is a recess for the noon meal. For those who live in the dormitory, there is only half an hour recess They have to work half an hour more each day in order to compensate for the cost of fuel which the filature furnishes to them.

The wages of the women vary. In Yung-kei, where labor is comparatively high, a woman can get a dollar a day. In Kung-hang the wages average about fifty cents a day.

The ages of the women range from 13 to 45 years, 20 to 30 being the most common. A woman will get her best wage when she is 25 to 30 years of age, if she was trained when young.

The women get their training by watching others do the work. The filature does not have special facilities for training them.

The Foremen.—The duty of the foremen is to supervise the women's work. Besides knowing the art of reeling cocoons, of which they usually have at least eight or ten years of experience, they must be very wise in judgment. A good foreman should know each girl individually and treat her with suitable methods. Sometimes it is very necessary to use round about methods to settle difficulties.

There is a great difference in the ability of the reeling girls to use the *Chambon* system of reeling. With some girls the threads break all the time. The skilful worker is always busy; she keeps the threads going all the time, and while something is going on, which she still has to keep her eyes upon, she prepares for something else. She wastes no time. The writers have watched them work for hours and found many have bad habits, while some of them are very sluggish in their work.

To judge a woman's work, upon which her wage is determined, the foreman takes into consideration many factors.

Firstly, the age of the woman.

Secondly, the temperament and disposition, which they can judge by her behavior and the appearance of her face.

Thirdly, cleanliness and orderliness of work.

Fourthly, the quantity of cocoons a woman puts into the basin at one time. This becomes a habit and the women are slow to change when told to put in less.

Fifthly, the amount of pulling and motion which the reeling girl exerts with her left hand on the ends of the cocoon fibers. The less pulling the better.

Sixthly, the quantity and quality of silk a girl can finish from a given quantity of cocoons in a day.

There is a head foreman known as the "big bookkeeper (揸人部). He determines the amount of wages paid to the girls. He is the head of the filature proper and has power to direct the fireman and engineer. The success of a filature depends very much upon his ability to supervise the work.

The Engineer and the Fireman.—The engineer and the fireman must regulate the speed of the engine to suit the reeling of the cocoons. Good cocoons will unwind easier; the fibers are stronger and consequently there are less breaks. With a good quality of cocoons the engine may be made to run faster with just as good results. On the other hand, if the cocoons are of poor quality and if the engine is running faster than it should, the reeler will find it hard to maintain a sufficient supply of ends of cocoons to be thrown to the thread, and consequently, the thread will be thin and irregular which will give rise to defective silk.

The engineers are locally trained. They get their skill by practice and observation. They know practically nothing about the theoretical side of the engines though they understand the use of them. This is generally very true of the local machinists in China. As a matter of fact, there is a great deal of energy lost by friction in the gears and belts which is due to their improper arrangement and adjustment.

The Rereeling of Silk for American Consumption

Function of the Rereeling Room.—America demands quality silk; this makes the rereeling process necessary. With the tremendous difference of wages in the two countries, it goes without question that the rereeling process should be done here. Every modern filature is now provided with a rereeling room in which the 14/16 and 20/22 denier silk prepared to meet the American demand are rereeled, while the 13/15 denier silk for French consumption is sold without rereeling.

Construction of the Rereeling Room.—This room is provided with a better system of ventilation and lighting than the reeling room. There are more windows in the walls as well as in the roof. Moreover there are no hot water basins in this room and consequently the temperature and humidity are not so high as in the reeling room. In fact, the women work much more energetically here than in the reeling room.

The Equipment of the Rereeling Room.—A small engine of similar type to the main engine is placed at one end of the room. It is operated with steam pipes from the boiler. There are four rows of rereeling machines each having 22 reels, making a total of 88 reels. The four rows are divided into two pairs, or in other words there are two double rows. Between these double rows as well as near the side of the walls of the room, there are lightly constructed wooden shelves on which to place the small reels as they come from the reeling room. At about ten foot intervals between these shelves are placed basins of cold water for wetting the silk before rereeling.

The Rereeling Process.—In the rereeling process silk from four small reels is transferred to four standard skeins on the rereel. The four reels of silk are first wet with a little water to soften the gum spots and prevent breaking and then placed on a board lying on the ground in front of the rereeling machine. The woman then finds the end of the thread from each reel of silk and rolls it together into a large thread to be passed through the button hole. After each thread passes through its respective button hole, the rereeling girl ties the ends of the four threads to the axel of the reel, and lets down the lever of the machine and the rereeling process begins. One girl can take charge of sixteen to twenty threads. Although the rules regulating the rereeling room require that every woman should watch, report, and remove every defect she comes across, she seldom follows strictly while the foreman often neglects to see that the regulations are properly carried out.

When the rereeling of the silk from each small reel is about half done, a small piece of paper bearing the trade mark of the filature is put into the skein of silk.

It takes about three and one half hours to complete the rereeling of the silk from a small reel. When the four skeins on the rereel are finished, the girl ties the ends of the four threads to one corner of the reel and attaches one of her bamboo checks to the hook on the reel. The bamboo checks of each of the four small reels are put on a hook under their respective skeins. After this, the cover of the rereeling machine is opened and this means that the rereeling is finished. There are women especially employed to remove the reel, the skeins of silk will then be dried and packed. Another reel is immediately put into the vacant place and the girl starts the rereeling process again.

The Rereeling Girls and their Working Conditions.—There are twenty rereeling girls most of whom are young. It seems to be a distinct advantage to be employed in the rereeling room. On the other hand, it is a decided advantage to employ young girls, for they are more sensitive to the warning and criticism of the foreman. They will, therefore, take better care of their work. About a third of the rereeling employees determine not to be married and are called "chue-soh-mui" (自梳妹), this being very common in the silk districts of Kwangtung. They work to support themselves. The rest are young girls, and married women who work, as most of them do, to help to finance their homes. It is not uncommon to find all the women of a family working in a filature. The reeling and rereeling girls, especially the latter, are nicely dressed. Their daily wages, which are highest during the summer months, vary from fifty cents to $1.00. This includes rewards for full attendance. It may be reduced to one half or even less in early spring or late winter when only a few of the filatures are running.

All the rereeling girls know how to reel cocoons as well. When the rereeling department of a filature stops working, the girls have either to go to another filature or work in the reeling room. This often happens when 13/15 silk is reeled.

It is extremely interesting to study the opinion of the rereeling as well as the reeling girls. When they are asked, "Are you tired of your work?" The answer is always very simple, "No, we are making money, how can one be tired if one is making money?" The workers in the rereeling room are quite satisfied with their work and few of them have ever made complaints.

Contented as they are, their work is by no means pleasant. Though, comparatively speaking, working in this room is more comfortable than in the reeling room, yet due to the uncovered steam pipes and its nearness to the reeling room, the room temperature usually exceeds 90° F. in the hot summer afternoons.

The work in the rereeling room continues from 6:30 A.M. to 6:30 P.M. with only half an hour of rest between 9:30 and 10:00 A.M. As stated above, each girl takes care of from sixteen to twenty threads. The writers have observed that the threads can not continue to be rereeled unbroken for longer than one minute when rereeling the silk from a poor lot of cocoons. This means that the girl has to work all the time without stopping.

The Foreman of the Rereeling Room.—There is only one foreman in the rereeling room. He is usually an experienced man who has climbed to his present position from the very bottom of the filature as an office boy. He is supposed to know all the defects in the silk, and the tricks which the reeling and rereeling girls have. His duty is to see that the rereeling room is running in good order and check every defect that the rereeling girls find during the rereeling. When 13/15 silk is to be prepared, this foreman acts as a foreman in the reeling room.

After the silk is rereeled, it is dried on the reel and later packed.

Packing

The Packing Room.—This is a small room located at the end of the rereeling building. It is equipped with a drying shelf, twisting apparatus, pressing machines and other packing outfit.

The Packing Process.—The packing process may be divided into the following steps:

Lacing: The silk on the rereel is first given to the lacing girl who ties together the two loose ends of each skein, and laces four rounds of cotton threads through each skein of silk in order to prevent it from becoming tangled during the process of twisting and opening up the skeins when used. It takes a few minutes to complete lacing a rereel of four skeins. Kung-hang has four lacing girls.

The Drying: After lacing, the silk on the rereel is dried. The rereel is put on the drying shelf which may be closed off by a canvas curtain. This shelf is five by ten feet. It is heated with three charcoal stoves underneath and the temperature is about 150°F. The time of drying varies from fifteen to thirty minutes according to the amount of moisture in the silk. After drying, the silk is cooled to room temperature for about ten minutes before it is taken off for weighing.

The Weighing: The weighing, as has been explained previously, is primarily for checking each woman's work. Each skein of silk is accurately weighed and its bamboo check is thrown into the box labelled with the same weight as that of the skein of silk.

Twisting: This is done by two men. The equipment used is a pair of bamboo tubes and a brass fork. The method is simple but it requires skill and practice to do it nicely. There are four twisters in Kung-hang.

Pressing: A number of skeins of silk weighing eight catties are placed in the press. After putting the skeins in the right position, a position which will give the book the best appearance, the presser screws down the cover and presses the "book" into one half its volume and ties it tightly with cotton cords.

Wrapping: The book of silk is first wrapped with white paper, then with cotton cloth, and finally with water proof oiled cloth. The latter is taken off when the silk arrives at the main office in Canton. These eight catties of silk, packed and prepared in the above way, constitute a "book". Eight "books" form a bale.

Defects in Raw Silk and their Dectection in the Filature

The uses of Canton silk are greatly handicapped by its defects. Nearly all the defects are made in the reeling room and will reveal themselves in the rereeling process. The fundamental improvement in the filature so far as defects are concerned is therefore in the reeling room. As a matter of fact, if the equipment and management in the rereeling room were efficient so that no defects could escape detection, the reeling women would be forced to do good work. Unfortunately this is not so in most of the filatures. Only a few of the defects are detected and still fewer of them are removed even when detected. There are always a number of rules posted on the wall requiring the women to report and remove every defect in the silk, but these rules are not rigidly enforced. Thus defective silk is the result. The following are the most common defects found in the Canton Silk:

1. Inaccurate Size. When there are too many or not enough cocoons used to form a thread, over or under size will result. The way in which the sizing machine is used has been presented under equipment. It takes about fifteen minutes to test two women's work. The operator can arrange to wind two women's silk on the machine and thus can reduce the amount of work by one half. There is only one machine in the whole filature and the number of women tested each day is limited to from forty to sixty.

When a woman is found to be producing over or under size silk, she receives a fine, the amount of which is proportionate to the number of denier variation, from the required size. The following list of fines is copied from the Kung-hang filature.

Table for 20/22 Silk

Excess deniers	Fine	Under deniers
21.5	5c.	19
22	10c.	18.5
22.5	½D[*]	18
23	1D	17.5
23.5	2D	17
24	4D	16.5
24.5	6D	16
25	8D	15.5
25.5	10D	15
26	X[†]	15—

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[*] D is the amount of payment the girl receives daily.

[†] X means that all the wages the filature should pay to the girl is withheld. It must be understood that the wage of every girl is calculated the 1st and 15th of each month and paid on the 1st and 20th of each month. If the girl prepares silk with either 26 or more, and 15 or less deniers, she cannot work in the filature any more; all of the amount the filature should pay to her, had she not prepared such inaccurately sized silk, will not be given to her.

The list for 13/15 silk is approximately the same and for that reason is omitted.

When a girl is found to produce inaccurately sized silk (either under or over) she may occasionally quarrel with the foreman saying that she is following the directions and is always using so many cocoons. To settle cases like this, the foreman takes a few inches of her silk, that seem to be inaccurate, and puts them on a mirror. He adds a few drops of water to the silk thread to soften the gum and by using a needle, he separates the thread into its component fibers. The number of fibers may now be counted and shown to the girl. After this, the girl can have nothing to say.

2. Double Thread. This is one of the most common defects. When either one of the two threads in the crossing breaks, and is not attended to promptly, such a defect will occur. If the break is in the lower crossing, it can be easily seen and adjusted, but if the break is at the upper crossing, it will pass over with the other thread and they will be wound on the reel as one thread. If the reeling goes on undisturbed, the double thread may continue for a great length without being detected. If the break is in the lower crossing, it will be followed by a break in the upper crossing as well; this is characterized by the formation of two slugs about one foot apart. The break on the upper crossing does not disturb the lower one and it is characterized by a very long double thread and a loose slug at the end nearest to the reel. This defect can be easily detected in the rereeling process, as the loose second thread cannot pass through the button hole and therefore causes a break. When this is the case, the rereeling girl has to report such a fact to the foreman and the reeler receives a fine of five cents. If the rereeler finds such a defect and does not report it, she will receive a fine of fifty cents. This often occurs when the rereeling girl knows the reeler personally.

3. Double Thread Knot. This differs from No. 2 in that there is a knot at the end of the double thread. This knot shows that the reeler has noticed the defect, but being too lazy to adjust it, she simply breaks the double thread and connects it to a single one and then continues with the reeling. It is characterized by a slug at the point of breaking and a knot at the connecting point showing that it is consciously done. If such is the case, there will be no loose end, the double thread may pass through the button hole easily in the rereeling process and thus escape detection. The chance of being caught is very small. The fine for this is fifty cents, ten times as great as for a double thread. Girls who do this will give a very bad impression to the foreman and are often dismissed from the filature.

4. Slugs due to Adding of too Many Cocoons at a Time. In the reeling process when the thread of a cocoon is broken, it is immediately replaced by another one so as to keep the number of cocoons to the thread constant. In order to have evenness of the thread, only

one cocoon should be thrown in at one time, but sometimes if the woman is lazy or careless about her work, she may let the number of cocoons run down to one half or even less; consequently she will add many cocoons at one time in order to start right again. When more than two cocoons are thrown in at one time, a slug is sure to be formed. This is one of the most common defects in the reeling process. A "bad throw" will also give rise to a small slug. Slugs, unless especially large, are not removed in the rereeling process.

5. Screw-like Thread due to Adding by Hand too Many Cocoons at one Time. This is similar to No. 4 except that in the former case the cocoons are added to the thread by twisting the thread and the ends of the cocoon fibers together with the fingers. It is characterized by having a very thin thread on the one end of the screw thread, and a number of very loosely twisted threads joined to it.

6. Large Threads or Waste. Before adding a cocoon to a thread its floss should be previously removed; only cocoons with a single unwinding end should be thrown in. If this is not observed, floss may be added to the thread and a very large thread will result. Large thread is usually removed in the rereeling process.

7. Long Knots and Unevenly Cut Knots. A well cut knot should not be longer than 2 mm. But due to the carelessness of the woman, a knot may be cut too long or only one thread is cut while the other remains. The latter is known to them as "triangular silk".

8. Broken Threads. Broken threads in the reeling process are usually connected in the rereeling, but careless handling in the packing process may break the thread.

9. Gum Spots. This is partly due to wetting the silk with too much water in the rereeling process, and partly due to the sharpness of the edges of the reels. Skeins with gum spots will have more breaks in the winding tests.

The By-products of the Filature

The Pupae.—In Kung-hang, a filature of 504 basins, there are about 640 catties of pupae produced every day. The pupae are used exclusively for feeding fish in the fish ponds. The price for pupae is 3 taels silver per picul. In many of the older filatures they only receive 30 per cent of the receipts from the sale of pupae, while the other 70 per cent is given to the clan which owns the filature. This practice originated from the fact that rent was formerly lower and the clan claimed 70 per cent of the value of the pupae as an addition to the rent. Formerly the pupae were very low in price and the request was thus granted. Now, in many of the newly established filatures, a fixed amount is given to the clan annually instead of giving 70 per cent of the receipts from the pupae. Kung-hang pays 1300 silver taels annually to the clan for pupae alone. If 70 per cent of the price of the pupa were given it would mean about 3500 silver taels.

Waste Silk.—There are two main kinds of waste silk, namely, the "entangled silk" and the "silk waste". These two terms are technical and need explanation. The entangled silk is of little importance as it amounts only to about a picul a year. It is accumulated in the reeling and rereeling rooms in the process of tying knots and finding ends of skeins, etc. It is sold at $1.00 a picul. When the price of the silk waste is high the filature is tempted to mix it with the silk waste. Such a practice spoils the quality of the silk waste as will be shown later.

The silk waste is different from the "entangled silk" in that it is accumulated in the process of reeling only. When the cocoons are prepared for reeling the floss is removed with the brush and chop sticks. This part of the cocoon, the floss, is one of the components of the silk waste. Again, in the process of reeling, the reeling girl has her left hand constantly holding and pulling the ends of the cocoon fibers. This is absolutely necessary in order that she may have a good supply of ends of cocoons to be thrown into the threads whenever needed. She often winds these cocoon ends into circles. The latter makes the process of manufacture difficult as this by-product is the raw material for the manufacture of spun silk; it breaks the needles of the combing machine. For the same reason the "entangled silk" should not be mixed with the silk waste.

Kung-hang produces about 80 catties of silk waste a day, the quality of which depends upon the quality of cocoons used and the skilfulness of the reeling and rereeling girls. For every catty of silk prepared, about nine to thirteen taels of silk waste is produced. The price of the silk waste also fluctuates the same as raw silk itself. It ranges from $100 to $180 a picul.

When ten or fifteen bales of silk waste have accumulated in the filature, they are sent to the Canton head office, on the silk boats. There are shops that collect the silk waste and sell it to the foreign exporters in Shameen.

Cocōons Unsuitable for Reeling.— Another by-product of the industry is the cocoons unsuitable for reeling, that is, the cocoons bitten by mice, cocoons with fly maggot holes, pierced cocoons, and sunken cocoons. All these cocoons are termed "kaan-hou". (繭口). They are sold to the villagers in Lung-kong (龍江) where they are unwound into very coarse threads known as "kaan-sha" (繭沙). The selling price of these cocoons is fifteen cents a catty (wet).

The method of unwinding is very simple; it consists of using a big hand turned reel on which the silk is to be wound, and a small wheel by which the twisting for cohesion is obtained.

The method of unwinding may be the original method devised for the unwinding of silk cocoons.

Kung-hang produces 60 catties of this kind of cocoons daily. In many of the filatures, such a by-product is given to the workmen as a bonus known as "Tei-sha" (地沙), which may amount to a few thousand dollars a year. Filatures with such a bonus will have a much lower monthly wage for the workmen.

A woman can prepare about five taels of "kaan-sha" a day. She receives about eight cents silver for every tael of it prepared. The selling price of the "kaan-sha" is fifty cents a tael. Most of it is used locally and woven into a kind of coarse cloth known as "kaan-chou" (繭綢). Much of it, however, is exported to Bombay India, where it is known as "punjum".

Reward and Fine System

In order to encourage the women to do good work and to be regular in attendance, a complex system of rewards and fines is worked out in each filature. The system adopted by all filatures is similar. The rules of the system are subject to change at any time at the disposal of the foreman who will offer more rewards when the supply of labor is scarce, and vice versa. As has been stated above, the wages of the women are computed every fifteen days. At times when labor is scarce, if a woman has fifteen days of regular attendance, she will receive a payment of four days extra; if she has fourteen days of regular attendance, she will receive an extra payment of two days. There is no extra payment if she attends thirteen days out of the fifteen days. The extra payment is called "kan-kung" (勤工).

There are a number of rules regarding lateness, leaving the filature without permission, quarreling, etc., but the most important ones are those regarding the reeling, rereeling, and lacing of silk. A complete list will be presented.

1. Inaccurate size (this has been presented above).

2. High and low quantity of silk. It has been mentioned in connection with the checking system that it is possible to trace out the reeler of each skein of silk. If the weight of a skein is 0.3 taels under the required weight, a fine of ten cents will be imposed on the reeler. On the other hand, a reward of two cents is offered for each one-tenth tael more than the requirement. If the extra quantity of silk reeled by a woman exceeds 3.3 taels in a period of fifteen days, one additional cent is given for each one-tenth of a tael increase.

3. The reeling of double threads receives a fine of five cents each.

4. The reeling of double thread knots receives a fine of fifty cents.

Rereeling Room. The rereeling girl should watch and report every defect to the foreman who in turn punishes the reeling girl. According to the regulations, failure to do this will be subjected to the following fines :

1.	Double threads	$.50
2.	Double thread knot	.50
3.	Double thread removed secretly without reporting to the foreman	1.00
4.	Removing defective silk without reporting to the foreman	.50
5.	"taan-chin-ngan-poh" （單錢眼泡）	.20
6.	Broken thread	.30 each
7.	Hairy silk not reported	.10
8.	Connecting a broken end to the wrong reel	.10 each
9.	Large thread	.10
10.	Passing a thread through the wrong button	.10
11.	Uneven thread	.10
12.	Stained silk	.10
13.	Gum spot due to too much wetting with water	.10
14.	Placing the bamboo checks under the wrong skein of silk	.10
15.	Uneven cutting of knot	.10
16.	Forgetting to put on the rereeler's own check	.10
17.	Forgetting to stick together the loose ends of the threads after the rereeling is finished	.10
18.	Loose threads on the side of the reel	.10

Lacing :

1.	Breaking the threads due to careless lacing	.10
2.	Forgetting to tie together the two ends of the skeins	.10
3.	Prominent defects on the surface of the skein not reported	.10
4.	Coarse threads, loose threads, not removed or adjusted	.10

The Water Supply in the Filature

The water used in the filature has a great influence upon the color of the product. Every filature filters the water before using it. A large pond is made in which is built a brick filter. The brick filter usually consists of three compartments, each of the latter being separated from the other by a brick wall. In this way the water is filtered three times through the bricks before it is pumped to the basins.

A compressed air pump is used, connected to the engine on the other side of the flywheel. Water is first pumped up to a tank where it is again filtered. In this filter, sponge is used, as it will remove all the suspended mud in the water. With such an arrangement, the water should be very suitable for reeling.

The Coal Supply

Japanese coal is used throughout the district. There are coal merchants who buy in Hongkong and resell in the silk districts. A filature of five hundred basins consumes about two and one half tons of coal a day. There are 167 filatures which will burn a total of about four hundred tons of coal a day. The coal is unloaded in Yung-kei and then reshipped to the other parts of the district. The cost of labor in loading or unloading a ton of coal is thirty cents. The duty for a ton of coal is about sixty cents. So if coal is selling at $15.00 HK., in Hongkong, its selling price in the silk districts will be $25.00 local currency. The furnaces of most of the older filatures are poorly constructed, and a great deal of fuel is wasted. It is believed that if the reeling and rereeling, especially the former, were properly geared, the amount of fuel used could be reduced from one quarter to one half.

The Cost of Manufacture

This topic is presented with a view of giving a general idea of the cost of manufacturing raw silk. Due to insufficient data the writers have not been able to present a complete calculation on the yearly basis, but from the actual data obtained, a general view of the subject can be presented. Before going into the subject, it is necessary to consider some of the factors that cause the fluctuation in the cost of producing raw silk.

1. *The Number of Manufacturing Days in the Year.*—Because of the scarcity of cocoons in the late winter and in early spring, many filatures have to stop running from one to three months in the year The number of working days in a year varies from 250 to 300 or a little more. But during the time when the filature is not running, is has to pay nearly all the expenses as if it were running, except the wages of the women. Naturally the fewer the number of working days, the greater would be the cost of production in that year, and vice versa.

2. *Fluctuation of the Price of Cocoons.*—The price of the cocoons is more than seventy per cent of the cost of producing raw silk. But the price of cocoons fluctuates so widely that it is impossible to make a reliable estimate before hand.

3. *The Variation in the Quality of the Cocoons.*—The quality of the cocoons varies widely even in the same crop, from the same vicinity. A study of the records in the filature will show that twice as much waste silk is produced from the poor grade cocoons as from the good ones. As a matter of fact, the price of waste silk is only one-fifteenth that of raw silk. Consequently the cost of manufacture with poor grade cocoons will be much higher.

4. *The Fluctuation in the Wages of the Reeling Women.*—The wages of the same woman doing the same kind of work varies greatly during the year. Generally the wages are at their highest in the summer and autumn months. At this time there is the maximum supply of cocoons to be reeled; every filature is looking for reeling and rereeling girls. In late winter and early spring only a few of the filatures will have enough stored cocoons to keep them running and the demand for reeling and rereeling girls is descreased to the minimum. At this time the wages may be cut down to one half or even less, and all the rewards (but not the fines) will be discontinued.

5. *Size of Silk to be Produced.*—There are three main sizes of silk manufactured in the filatures, i.e., 13/15, 14/16, and 20/22 deniers. The cost of preparing each is different; the first, which is exported to France, needs no rereeling so the process costs about $50.00 per picul less.

A study of the above mentioned factors will show that the cost of manufacture is subjected to high fluctuations. Moreover, the Kung-hang filature, in which the writers carried out their investigation, is a new one, and had only two months of full data. We will not attempt to present any definite figures on the cost of manufacture. A rough estimate, however, will be attempted.

The average cost of manufacturing coarse silk throughout the year is 210 to 220 taels silver per picul; for fine silk it is 300 taels per picul. These figures agree with those of the many filatures in the district for this year.

SUGGESTED IMPROVEMENT IN THE FILATURE

The filature industry in South China is very strongly organized. Even with the present political disturbances and local disorder, the business goes on with little friction. Nevertheless, the present condition of the filatures is far from being satisfactory or perfect. Although the industry has a long history and changes can be effected slowly only, some reformation must be carried out sooner or later if the Canton silk is to retain its market. An outline of suggested improvements will be given below.

The Reeling and Rereeling Room.—When entering a filature the first thing that strikes one will be the high temperature and humidity. The fundamental cause of this lies in the steam pipes and the hot water; but with a better ventilation system, this intolerable condition can be improved. In the reeling and rereeling rooms there are windows in the walls as well as in the roof, but those in the roof have to be closed when there is bright sun shine or rain. Hence the combined effect of the accumulated heat and moisture makes the reeling of cocoons an almost intolerable job. With proper construction of the roof, the ventilation can be greatly improved. The side windows should be opened all the time to let out the rising steam and a continuous air current will be set up in the room. As a matter of fact this construction of the roof has already been adopted by a few of the best filatures in Yung-kei. It should be followed by other filatures also.

The Store Room.—The store room is subject to two criticisms. First, there are only a few small windows to admit air and they are often closed; hence there is practically no ventilation. Second, its ground floor is usually kept damp for softening cocoons, consequently the humidity in the building is very high. This dampness and poor ventilation will cause the stored cocoons to become moldy. The store room should be provided with better ventilation and separated from the softening room.

Equipment

Steam Pipes and Belts.—There is a total of more than a thousand feet of steam pipe running to all parts of the filature. Many of the pipes are over one hundred feet away from the boiler. Strange to say the pipes are uncovered and the loss of heat through radiation is very great. Figuring on the basis that two and one half tons of coal are burned each day, at $25.00 Canton currency, per ton, the yearly loss of energy will amount to $45.00 Canton currency, assuming that twenty per cent of the energy is lost by radiation. This sum will be increased by the loss of energy through the poor arrangement of the belts, some of which are loosely fixed and others so badly twisted that the waste of energy through friction must indeed be tremendous. The steam pipes should be covered with asbestos and the belts should be arranged to give the maximum mechanical efficiency. Besides saving power, the covering of the steam pipes would prevent the heat from the steam pipes radiating into the rooms and making them hotter.

The Basins.—The basins have no outlet at the bottom. The superfluous water runs off from the sides of the basins, while the dirt or residue in the water, being much heavier, settles down to the bottom of the basin. So merely letting clean water into the basin cannot make the water cleaner. There should be an outlet of some sort near the bottom of the basin to remove the accumulated residue.

The Sizing Machine.—A filature has only one or two sizing machines which can test the work of two women at one time. Hence the number of women's work so tested daily is very limited. The women, knowing that their work is only occasionally tested, will take the risk of doing imperfect work as the chance of escaping detection is considerable. With more machines and a little more labor it would be quite possible to test each woman's work every day or every two days. Regular testing of the women's work is strongly recommended. In the sample taken, not only should the number of deniers be correct, but the detection of other defects in the raw silk should be equally emphasized.

Water Supply.—Water, as has been mentioned above, is the essential factor for producing silk of superior color, but many of the filatures are a little careless about their water supply. During the time of the writers' investigation, the filatures had special trouble with the flood, which comes every year during the summer months. Some of the filatures stopped running for weeks, partly due to the fact that clean water was not available for the reeling. With proper construction of the filatures, such trouble can be avoided.

The Reels.—The circumference of the reels is not uniform. The writers measured many of them and found that they varied commonly from one half inch to one inch. The edges of the reels are too sharp, giving rise to gum spots in the silk.

The Rereeling Machine.—In the rereeling process the thread passes from the small reel to the standard reel. There is nothing on the glass rod to break the thread if the latter has defects in it. Nor is the hole in the button, through which it passes, small enough to do this. In fact, in the rereeling process, any defect except very thin thread or under sized silk will pass onto the rereel without being detected at all. As a matter of fact, the function of rereeling is to prepare a better quality of silk. It increases the cost of production to rereel the silk. and if a better quality cannot be obtained, the process seems superfluous. To remedy this, the hole in the guide button should be made small, and there should be a device of some sort that will make it impossible for the defects in the silk thread to pass onto the rereeled skein. This of course means more labor. It would be much better, however, not to rereel at all if better quality of silk cannot be obtained.

The Grading of Cocoons.—When first bought in the warehouse the very poor cocoons have been sorted. But the cocoons used in the filature are still not very uniform in quality. They can be profitably graded into at least two grades, and then reeled by two classes of women into two different grades of silk, which, according to the principles of marketing, will bring better prices. One of the greatest handicaps of Canton silk is that it has no grade. The silk produced in any filature may vary widly in quality from time to time, yet the producers always claim that their silk is of the same superior quality in order to make a sale. As a result, the consumer knows nothing about what he is going to get. The grading of cocoons, which is the first step in preparing graded silk, is an essential process.

The Softening and Soaking of Cocoons.—Although the workmen take great pride in their art, the softening process is neither scientific nor economical, as it takes days to complete the process, while the success depends solely upon judgment. With the present method of preparing cocoons, the temperature of the water for soaking is as high as 195°F. Even with this high temperature the white gum spots on the cocoons, which are an indication of insufficient soaking, do not disappear. As a result of this, the women have to reel the cocoons under great difficulties, and accomplish comparatively less work each day, the cocoon fibers breaking so frequently and having to be rebrushed to find the ends again. This is one of the chief causes that gives rise to the large quantity of waste silk in preparing a given quantity of raw silk. Sometimes the amount of waste silk exceeds one catty when a catty of raw silk is prepared. If the cocoons could be properly prepared before delivering to the women for reeling, as is practiced in Japan, there would be less trouble in reeling them, and fewer breaks of the fibers which means less waste of silk. Also the temperature of the reeling basin could be greatly reduced.

Method of Reeling.—The present method of reeling in South China is the *Chambon* system. With this system one woman can take charge of only two threads. When one thread goes wrong both threads have to stop immediately. In other parts of the world the *Tavelle* system is used with each thread runing independently. It is claimed, however, by the filature men that due to the special fineness of the Canton silk, the *Tavelle* system, although very efficient, cannot be used. If such is the case, the present method should be retained and perfected. But this statement should be proved experimentally.

The Method of Holding the Ends.—Due to the frequent breaking of the fibers of the cocoons, the women have to keep a large supply of ends of cocoons in their left hands to be thrown in when necessary. Their methods of pulling differ and should receive a full discussion. Some hold their left hand very high with much to and fro motion. Of course the higher the hand and the greater the motion, the more the silk will be pulled off the cocoons. Silk thus formed can be sold only as waste silk, although it is good middle layer silk. The reelers who hold their hands high and employ much motion should be classified as poor workers, and should be eliminated if possible. After pulling the silk off the cocoons in order to maintain a number of ends of cocoons in her hand, the girl sometimes folds the silk in her hand, while another one may twist it around her fingers forming circles. The latter turns the waste silk into badly tangled loops which will greatly handicap the process of combing out the waste silk in the process of manufacture. So if good quality waste silk is to be obtained, no twisting of the silk into loops or circles should be allowed.

The Changing of Water in the Basin.—Although it takes only a few minutes to change the water in the basin, the water is never changed until the end of each day's work. With more frequent changes to clean water, silk of better color could be obtained.

The Drying of the Waste Silk.—The waste silk is first put into a specially constructed container in which the water content is squeezed out by a screw press. After the water is removed the waste silk is dried by hanging it over the boiler, the temperature of which is extremely high. With such a temperature, the waste silk is often burned and becomes what is known as dead silk. Such a method of drying should be discontinued.

The Employees

The Working Hours.—With eleven and a half hours of work per day, (eight hours of continuous work after the second meal at 9:30 A.M.), and seven days of work every week, in a room the temperature of which usually exceeds 90°F., one cannot help wondering how it is possible for a human being to work under such conditions throughout the entire year without breaking down in health. A glance at their attendance record reveals the truth. The irregular attendance indicates very clearly that many of the working women are compelled to stop working on account of sickness. The month in which the writers investigated was the month in which the wages are the highest, yet the attendance was very irregular.

The reward for full attendance, which has been mentioned above, is another factor which drives them to exhaust themselves to the utmost.

There is no doctor and no hospital in the filature. The only help that the filature can give in case of accidents is to provide a few common medicines which are supposed to be helpful for all kinds of diseases. In a factory of more than five hundred employees working under such conditions, at least a nurse, if not a doctor and hospital, should be provided. If the welfare of the employees is not attended to, mere improvement and enlargement of the industry will mean greater suffering to the unfortunate girls of the district, as more of them will work in the filatures if the industry is enlarged.

The dormitory for the girls should be better ventilated and there should be playgrounds around the place so that the workers can find some recreation after working. Under the present treatment there is no possibility of any social activity, because time and place are not provided.

Child labor is another serious problem in the filature; due to scarcity of labor, large numbers of young girls are employed even in the best filatures. They receive only about one third of the wages, but work just as hard as the full grown women. Child labor should be restricted, or at least the working hours should be shortened.

The filatures do not train their women. It would pay, in the long run, to have a laboratory in the filature for training their own women, and at the same time testing the daily product of the filature.

The above suggested improvements are very practical and can be effectively carried out with little difficulty and expense. Another side of improvement of the industry that is of no less importance is the improvement of the quality of cocoons. This subject, however, is too large to be discussed here.

THE FILATURES IN YUNG-KWAI

The best steam filatures of South China are found in Yung-kwai. Generally they may be grouped into three classes. The first class consists of those the price of whose silk per bale is about $150.00 HK. higher than the third class. The silk from the second class is about $50.00 HK. higher than the third class. The third class contains the majority of the filatures.

The construction, organization, and management of all the filatures are similar, but the first and second class filatures owe their superiority to the following points:

1. They have a better construction of roof of the reeling room, with side windows which admit more light and reduce the temperature and humidity. This means a better place for the women to work, and consequently better work.

2. The reels rotate at a slower and more uniform speed. The women are therefore not forced to hurry their work.

3. The steam pipes are kept open during reeling, with steam at a definite pressure. The temperature of the water in the basin is more uniform and yet somewhat lower than that in the third class filature. Hence the cocoons are well softened and easily unwound.

4. The waste of the cocoons is more completely removed before reeling. This, of course, gives a better quality of silk, but a little higher percentage of waste.

5. The water used for reeling is clean because they have a better filter.

6. The rules for reward and fine are strict. The fine for incorrect size is very heavy so the women are forced to do careful work.

7. The upper and lower crossings are uniform and long, the lower one being nine inches and the upper one twelve inches.

8. Most important of all, however, is the type of women reelers. The women in Yung-kwai are said to be much more skilful. They are very obedient and follow the instructions of the foremen closely.

1. WOMEN SORTING COCOONS IN A COCOON MARKET.
2. SIZING SKEINS BEING WEIGHED, IN A STEAM FILATURE, ON A LOCAL MADE DENIER SCALE.
3. REELING SIZING SKEINS, IN A STEAM FILATURE, TO TEST THE WORK OF THE REELING WOMEN.

PHOTOS BY Y. W. LEI AND H. K. LEI

1. General view in a steam filature in Kwangtung.
2. Testing cocoons, in a steam filature, to see how many should be used for reeling a given size of thread.
3. Women at the basins in a steam filature.

Photos by Y. W. Lei and H. K. Lei

A LIST OF SOME SOOCHOW AND NINGPO DIATOMS.

By N. Gist Gee

China Medical Board, Peking, China.

Achnanthes brevipes Ag.	Nimrod Sound
Achnanthes lanceolata (Breh.) Grun	Soochow
Achnanthes marginulata Grun.	Nimrod Sound
Achnantes subsessilis Ktz.	Nimrod Sound
Achnantes subsellis var. *enervis* Fauv.	Nimrod Sound
Achnantes javanica Grun.	Soochow
Actinocyclus ehrenbergu Ralfs.	Ningpo
Actinoptychus undulatus Ktz.	Nimrod Sound
Amphipleura pellucida Ktz.	Soochow
Amphiprora alata Greg.	Nimrod Sound
Amphora costata W. Sm.	Ningpo
Amphora cymbelloides Grun.	Nimrod Sound
Amphora cymbifera Greg.	Nimrod Sound
Amphora ergadensis Greg.	Nimrod Sound
Amphora Hemicolor Grun.?	Soochow
Amphora lineata Greg.	Nimrod Sound
Amphora ovalis (Breb.) Ktz.	Soochow
Amphora ovalis var. *gracilis*	Soochow
Anomoeoneis sphaerophora (Kuts.) Cleve	Soochow
Arachniodiscus ehrenbergii Bail	Nimrod Sound
Biddulphia aurita (Lyng.) Breh.	Nimrod Sound
Caleneis Silicula (Ehrenb.) Cleve	Soochow
Chaetoceros bacillaria Bail.	Ningpo
Cocconeis lineata (Ehr.) Grun.	Soochow
Cocconeis ningpoensis Fauv.	Ningpo
Cocconeis placentula Ehr.	Soochow
Cocconeis scutellum Ehr.	Soochow
Cocconema gracile (Rab.)	Ningpo
Coscinodiscus concinnus W. Sm.	Nimrod Sound

Coscinodiscus excentriscus Ehr.	Ningpo
Coscinodiscus gigas Ehr.?	Ningpo
Coscinodiscus heteroporus Ehr.	Nimrod Sound
Coscinodiscus lineatus Ehr.	Ningpo
Coscinodiscus lineatus oculatus Fauv.	Ningpo
Coscinodiscus minor Ehr.	Ningpo
Coscinodiscus nodulifer A. S.	Nimrod Sound
Coscinodiscus oculus iridis Ehr.	Ningpo
Coscinodiscus radiolatus Ehr.	Ningpo
Coscinodiscus subtilis Ehr.	Ningpo
Cyclotella operculata Ktz.	Soochow
Cyclotella rotula (Ehr.) Ktz.	Ningpo
Cyclotella sinensis Ehr.	Ningpo
Cyclotella meneghinian Ktz.	Soochow
Cyclotella punctata W. S. (*Coscinodiscus lacustris* Grun).	Soochow
Cyclotella striata (Ktz.) Grun.	Soochow
Cymatopleura Solea (Breb.) W. Smith	Soochow
Cymbella affinis Kutz.	Soochow
Cymbella lunata Rab.	Soochow
Cymbella obtusa Greg.	Ningpo
Cymbella stomatophora Grun.	Soochow
Cymbella tumida Breb.	Soochow
Cymbella turgida (Greg.) Cleve	Soochow
Epithemia gibba Ktz.	Soochow
Epithemia westermanni Ktz.	Nimrod Sound
Epithemia zebra (Ehr.) Ktz.	Ningpo
Eunotia pectinalis (Kutz.) Rab. and varieties	Soochow
Frustulia styriaca (Grun.) D. T.	Soochow
Gomphonema acuminatum Ehr. with vars.	Soochow
Gomphonema acuminatus coronatum (Ehr.) Cleve	Soochow
Gomphonema acuminatum Turris (Ehr.) Cleve	Soochow
Gomphonema angustatum Kutz.	Soochow
Gomphonema augur Ehr.	Soochow

Gomphonema capitatum Ehr.	Ningpo	Soochow
Gomphonema constrictum Ehr.	Soochow	
Gomphonema intricatum Ktz.	Soochow	
Gomphonema lanceolatum Kuts.	Soochow	
Gomphonema micropus	Soochow	
Gomphonema montanum Schumann	Soochow	
Gomphonema parvulum Kutz.	Soochow	
Gomphonema sphaerophorum Ehrenb.	Soochow	
Hantzschia amphioxys Grun.	Soochow	
Hantzschia elongata (Hantzsch.) Grun.	Soochow	
Hyalodiscus subtilis Bail.	Nimrod Sound	
Lysigonium varians (Ag.) De-Toni	Soochow	
Melosira crenulata Ktz.	Soochow	
Melosira sulcata (Ehr.) Ktz.	Ningpo	
Melosira varians Ag.	Soochow	
Melosira costata Grev.	Ningpo	
Navicula ambigua Ehr.	Soochow	
Navicula americana minor M. Perag. and Heribaud	Soochow	
Navicula amphirhynchus Ehr.	Soochow	
Navicula appendiculata Ktz.	Soochow	
Navicula bisulcata Lag.	Soochow	
Navicula Braunii Grun.	Soochow	
Navicula Brebissonii Ktz. with varieties	Soochow	
Navicula cuspidata Kutz.	Soochow	
Navicula elliptica W. Sm.	Ningpo	Soochow
Navicula elongata Grun.	Ningpo	
Navicula gemina Ehr.	Ningpo	
Navicula gracilis Ehr.	Nimrod Sound	
Navicula graeffii Grun.	Ningpo	
Navicula limosa Kutz.	Soochow	
Navicula longa Greg.	Ningpo	Nimrod Sound
Navicula parca A. S.	Ningpo	
Navicula pupula Grun.	Soochow	
Navicula major Grun.	Soochow	
Navicula smithii Breb.	Ningpo	

Navicula sp.	Nimrod Sound
Neidium affine (Ehrenb.) Pfitzer	Soochow
Neidium amphigomphus (Ehrenb.) Pfitzer	Soochow
Nitzchia acutiuscula Grun.	Soochow
Nitzchia amphibia Grun.	Soochow
Nitzchia angustata (W. S.)	Soochow
Nitzchia compressa (Bail.)	Ningpo
Nitzchia distans Greg.	Nimrod Sound
Nitzchia macilenta Greg.	Ningpo
Nitzchia minuta Bleisch.	Nimrod Sound
Nitzchia Palea (Ktz.) W. S.	Soochow
Nitzchia panduriformis Greg.	Ningpo
Nitzchia sigma (Ktz.) W. S.	Ningpo
Nitzchia thermalis (Ktz.) Grun.	Soochow
Nitzchia tubicula Grun. doubtful	Soochow
Nitzchia (Homaocladis) *vidovichii* Grun.	Nimrod Sound
Pinnularia borealis Ehrenb.	Soochow
Pinnularia gibba (Kutz.) Van Heurck	Soochow
Pinnularia hemiptera (Kutz.) Cleve	Soochow
Pinnularia major (Kutz.) W. Smith	Soochow
Pinnularia Viridis Nitzsch.	Soochow
Pleurosigma affine Grun.	Nimrod Sound
Pleurosigma acuminatum W. S.	Ningpo
Pleurosigma formosum W. S.	Nimrod Sound
Raphoneis fasciolata Ehr.	Ningpo
Raphoneis scutellnm Ehr.	Ningpo
Rhoicosphania curvata Grun.	Soochow Nimrod Sound
Rhoikoneis bolleana Grun.	Nimrod Sound
Rhopalodia gibba (Kutz.) Muller	Soochow
Podosira nummuloides Ehr.	Nimrod Souud
Stauroneis acuta W. Smith	Soochow
Stauroneis anceps gracilis (Ehrenb.) Cleve	Soochow
Stauroneis phoenicenteron Ehr.	Soochow
Stephanodiscus sinensis Ehr.	Ningpo
Surirella angusta Kutz.	Soochow
Surirella fastuosa Ehr. Type	Ningpo Nimrod Sound

Surirella fastuosa, many forms	Ningpo
Surirella gemma Ehr. abundant	Nimrod Sound
Surirella linearis W. Smith	Soochow
Surirella ovalis Breb.	Soochow
Surirella ovata Kutz.	Soochow
Surirella pinnata W. S.	Soochow
Surirella pinnata minuta Grun.	Soochow
Synedra danica Kutz.	Soochow
Synedra pulchella (Ralfs.) Ktz.	Soochow
Synedra rumpens Ktz.	Soochow
Synedra sp.? (Similar to *S. tabulata*) Ktz. which is brackish)	Soochow
Synedra ulna var. amphirhynchus (Ehr.)	Soochow
Synedra elma (Nitzsch.) Ehrenb. and varieties	Soochow
Sgringidium daemon Grev.	Ningpo
Triceratium rostratum Fauv.	Ningpo
Triceratium sineuse Schw.	Nimrod Sound

TENTATIVE LIST OF CHINESE DECAPOD CRUSTACEA

Including those Represented in the Collections of the United States National Museum (Marked with an*) with Localities at which Collected.

By N. Gist Gee

China Medical Board, Peking, China.

Foreword

For some years we have been endeavoring to get together for those who are working on the natural history of China lists of the various groups of plant and animal life. We have always found the most sympathetic cooperation on the part of specialists and institutions. We have felt that the determination and naming of the various forms should be done only by those who are specialists in the group concerned. This is most necessary in order to avoid errors and consequent difficulties in the future. With this view in mind we have always submitted our lists to those who were competent to express a final opinion on the list as a whole. It is very evident that these lists cannot be complete, for we know so little of the occurrence of the various forms, but in order to make it possible for workers to have a beginning, we have held that it was best to publish *preliminary* or tentative lists which might serve as a starting point for more nearly complete lists later.

The following list, has been kindly compiled for us by friends in the United States National Museum at Washington. It makes no claim to being a complete one, but gives us most of the records of this group from China. It will serve as an excellent basis for further work.

Peneidae

Penaeopsis mogiensis (Rathbun)	Hongkong
**Penaeopsis monoceros* (Fabr.)	Hongkong; *Wen-chow.
Parapeneopsis hungerfordi Alcock	Hongkong
Parapeneopsis sculptilis (Heller)	Hongkong
Penaeopsis joyneri (Miers)	China
Penaeopsis novae-guineae (Haswell)	Hongkong
Peneus affinis Heller	Hongkong

?*Peneus podophthalmus* Stimpson	Hongkong
Peneus semisulcatus de Haan	Hongkong
?*Peneus stenodactylus* Stimpson	Hongkong
**Peneus* sp.	*Pei-tai Ho, Chihli; on the north coast of the Pechili Gulf, China.
Sicyonia ocellata Stimpson	China Sea; Hongkong
**Trachypeneus curvirostris* (Stimpson)	*Wen-chow, China.
SERGESTIDAE	
Acetes chinensis Hansen	China Sea
Acetes serrulatus Kryer	Indo-Chinese Sea
Acetes spiniger Hansen	Indo-Chinese Sea
Lucifer hanseni Nobili	China Sea
Lucifer intermedius Hansen	China Sea; Hongkong; Shanghai.
Lucifer penicillifer Hansen	China Sea; Hongkong; Shanghai.
Sergestes orientalis Hansen	China Sea
PASIPHAEIDAE	
Leptochela robusta Stimpson	China Sea
ATYIDAE	
Caridina davidi Bouv.	Peking
**Caridina denticulata* de Haan	*Near Yen-Ping Fu, Fukien
Caridina denticulata subsp. *sinensis* Kemp	Tai Hu Lake, Kiangsu.
Caridina nilotica subsp. *gracilipes* de Man	Shanghai; Whangpoo River.
Caridina serrata Stimpson	The Peak, Hongkong
CRANGONIDAE	
Arete dorsalis Stimpson	Hongkong
Crangon (Alpheus) avarus (Fabr.)	Hongkong
Crangon (Alpheus) distinguendus (de Man)	China
Crangon (Alpheus) hoplocheles (Coutiere)	Amoy
Crangon (Alpheus) neptunus (Dana)	Hongkong
Crangon (Alpheus) strenuus (Dana)	China
Ogyris orientalis Stimpson	China Sea

HIPPOLYTIDAE

Hippolysmata vittata Stimpson	Hongkong
Latreutes Mucronatus Stimp.	Hongkong
Tozeuma lanceolatum Stimpson	Hongkong

PROCESSIDAE

Processa macrognatha (Stimpson)	Hongkong

CRAGONIDAE (Crangonidae)

Pontophilus carinicauda Stimpson	Hongkong

PALAEMONIDAE

*_Macrobrachium asperulus_ (von Martens)	*Yen-ping Fu; -Foochow; Tai Hu Lake, Kiangsu.
Macrobrachium hainanense Parisi	Hainan
*_Macrobrachium nipponensis_ (de Haan)	Canton; -Min River, Fukien; *Wenchow; Shansi; Yangtse-Kiang; Shanghai; Tai Hu Lake, Kiangsu; Peking;-Pei-tai Ho.
Macrobrachium superbus (Heller)	Shanghai
Macrobrachium venustus (Parisi)	Hainan
Palaemon (Leander) carinatus (Ortmann)	Shanghai; Tsingtau.
Palaemon (Leander) annandalei (Kemp)	Shanghai; Whangpoo River
*_Palaemon (Leander) japonicus_ (Ortmann)	*Foochow; Fukien; Hankow.
Palaemon (Leander) longicarpus (Stimpson)	China
Palaemon (Leander) modestus (Heller)	Shanghai; Whangpoo River; Tai Hu Lake Kiangsu.
Palaemon (Leander) pacificus (Stimpson)	Hongkong
*_Palaemon (Leander) serrifer_ (Stimpson)	Hongkong; Amoy; *Wenchow; Hankow.
*_Palaemon (Leander) paucidens_ de Haan	*Shanghai; Foochow.
Palaemon sinensis (Solland)	Shanghai; Whangpoo

PALINURIDAE	
?Linuparus trigonus (Siebold)	Ningpo
Panulirus ornatus (Fabr.)	Hongkong; Amoy; Swatow.
SCYLLARIDAE	
Ibacus novemdentatus Gibbes	Hongkong
Scyllarus sordidus (Stimpson)	Hongkong
ASTACIDAE	
**Cambaroides dauricus* (Pallas)	*Crater Lake, Kirin Forest, Manchuria.
GALATHEIDAE	
Galathea orientalis Stimpson	China Sea ?
PORCELLANIDAE	
Pachycheles pectinicarpus Stimpson	Near Hongkong
Petrolisthes japonicus (de Haan) Stimpson	Hongkong
**Petrolisthes speciosus* (Dana) Stimpson	Hongkong Island; ? Amoy.
Porcellana latifrons Stimpson	Hongkong
Porcellana ornata Stimpson	Hongkong
Porcellana pulchra Stimpson	Hongkong
**Porcellana serratifrons* Stimpson	Hongkong; *Amoy
Raphidopus ciliatus Stimpson	Near Hongkong
CALLIANASSIDAE	
Gebia carinicauda Stimpson	Hongkong
PAGURIDAE	
Clibanarius clibanarius (Herbst)	Hongkong
**Clibanarius infraspinatus* Hilgendorf	*Toofue, and Amoy; -Amoy.
Clibanarius virescens (Krauss) Heller	Hongkong
Dardanus arrosor (Herbst)	China
Dardanus diogenes (Fabr.)	China
Diogenes edwardsii (de Haan) Stimpson	Hongkong; China Sea
Pagurus brachiomastus Thallwitz	China
Pagurus megalops (Stimpson)	North China Sea

Pagurus seriespinosus Thallwitz	China?
Spiropagurus spiriger (de Haan) Stimpson	Near Hongkong
HIPPIDAE	
?Albunea sp.	Ningpo
Mastigochirus gracilis Stimpson	China Sea
DROMIIDAE	
Conchoecetes artificiosus (Herbst) Stimpson	Off Hongkong
**Dromia dehaani* Rathbun	*Hongkong
DORIPPIDAE	
Dorippe dorsipes (Linnaeus)	Hongkong
Dorippe granulata de Haan	Chinese Seas
Dorippe sima M. E.	Ningpo
Dorippe facchino (Herbst)	*Foochow
CALAPPIDAE	
Calappa lophos (Herbst)	China
**Calappa philargius* (L.)	*Hongkong; Foochow
Cryptosoma granulosus de Haan	Chinese Seas
**Matuta lunaris* (Forskal)	China Sea; *Hainan
**Matuta planipes* Weber	Chefoo; *Pei-tai Ho, Chihli.
Mursia armata de Haan	China
**Orithyia sinica* (Linnaeus)	Swatow; Amoy; Ningpo; Hankow: *Pei-tai Ho, Chihli; *Foochow.
LEUCOSIIDAE	
Arcania globata Stimpson	Near Soon-Koo? and Hongkong Islands; North China Sea.
Arcania septemspinosa (Fabricius)	Near Hongkong
Iphiculus spongiosus Adams and White	Near Hongkong
Leucosia rhomboidalis de Haan	Hongkong
Leucosia obtusifrons unidentata de Haan	Hongkong
Leucosides rhomboidalis (de Haan)	Near Hongkong
Leucosides vittata (Stimpson)	Near Hongkong

Myra fugax (Fabricius)	Hongkong Harbor
Nursia hardwickii Leach	Hongkong
Onychomorpha lamelligera Stimpson	Hongkong
**Philyra pisum* de Haan	*Foochow; *Chefoo; Pei-tai Ho; Chihli; *Chin Bey.
Philyra platycheira de Haan	Hongkong
Philyra tuberculosa Stimpson	Near Hongkong
Philyra unidentata Stimpson	China Sea
PORTUNIDAE	
Charybdis anisodon de Haan	Near Hongkong; Shanghai
Charybdis callianassa (Herbst)	Ningpo
**Charybdis cruciata* (Herbst)	Hongkong; *Foochow
**Charybdis japonica* (A. Milne Edwards)	Macao; near Hongkong; *Chefoo; *Pei-tai Ho, Chihli; *Amoy.
Charybdis miles de Haan	Hongkong
Charybdis natator (Herbst)	Hongkong
Charybdis truncata (Fabricius) Stimpson	Hongkong
**Charybdis variegata* (Fabricius) de Haan	China Sea; Hongkong; *Amoy
Portunus (*Achelous*) *galdiator* (Fabricius)	China Sea
Portunus (*Lupocycloporus*) *gracilimanus* Stimpson	Hongkong
Portunus (*Achelous*) *hastatoides* (Fabricius)	Hongkong Island; Hankow
**Portunus pelagicus* (Linnaeus)	China Sea; Hongkong; Ningpo; *Hoichow
Portunus sanguinolentus (Linnaeus)	Hongkong
**Portunus trituberculatus* (Miers)	Tsingtau; *Chefoo; *Pei-tai Ho, Chihli; *Amoy
**Scylla serrata* (Forskal)	*Amoy; Hankow; Shanghai
Thalamita danae Stimpson	Hongkong
Thalamita sima Milne Edwards (?)	Near Hongkong
POTAMONIDAE	
Potamon (*Potamon*) ***anacoluthon*** Kemp	The Peak, Hongkong.

**Potamon* (*Geothelphusa*) *dehaanii* (White)	*Kuling (near Kiukiang)
**Potamon* (*Potamon*) *denticulatus* (Milne Edwards)	*Near Yen-ping Fu; Tai Hu Lake, Kiangsu
**Potamon* (*Potamon*) *shensiensis* Rathbun	*Inkiaphou, Shensi
Potamon (*Potamon*) *lansi* Doflein	Upper Yangtse-Kiang
**Potamon* (*Potamon*) *davidi* Rathbun	*Han-Tchong-Fou, and *Siufu, Szechuen
**Parathelphusa* (*Parathelphusa*) *sinensis* (Milne Edwards)	Canton; Hongkong; Whampoa; *Amoy; *Foochow; *Hainan
**Potamon* (*Potamoneutes*) *hainanense* Parisi	*Hainan
Potamon (*Potamon*) *koatenensis* Rathbun	Koaten
**Potamon* (*Potamon*) *tumidus* (Wood-Mason)	*Yunnan
Potamon (*Potamon*) *whiteheadi* Parisi	Hainan
Potamon (*Potamon*) *orientale* Parisi	Hainan

ATELECYCLIDAE

Kraussie nitida Stimpson	China Sea

CANCRIDAE

Cancer gibbosulus (de Haan)	China Sea

XANTHIDAE

Actaea granulata (Audouin)	China Sea; Hongkong
Actaea pilosa Stimpson	Hongkong
**Actaea obesa?* A. Milne Edwards	*Kulungsu Id.
Actaea rufopunctata Milne Edwards	China Sea
Actaea (*?Banareia*) *subglobosa* Stimpson	Hongkong
Actaea tomentosa (Milne Edwards)	Hongkong
Actumnus squamosus (de Haan)	China Sea
Atergatis dilatatus de Haan	China Sea
Atergatis integerrimus (Lamarck)	Hongkong
Atergatis ocyroe (Herbst)	China
Cymo memanodactylus de Haan	Hongkong Island
Epixanthus frontalis (Milne Edwards)	Hongkong

Eriphia sebana smithii Macleay	Near Hongkong
Galene bispinosa (Herbst)	Hongkong
Halimede fragifer de Haan	Near Hongkong
Halimede ochtodes (Herbst)	Hongkong
Halimede thurstoni Henderson	Hongkong
Heteropahope eucratoides Stimpson	Hongkong
Heteropanope glabra Stimpson	Hongkong
**Leptodius exaratus* M. E.	Hankow; *Amoy
Leptodius exaratus var. granulosus (Stimpson)	Hongkong
Leptodius gracilis Dana	Near Hongkong
Liagore rubromaculata de Haan	China Sea; Hongkong
Lophoxanthus scaberrimus Walker	Hongkong
-*Menippe convexa* Rathbun	Swatow; Kulungsu Id.
Ozius lobatus Heller	Shanghai
Pilodius granulatus Stimpson	Hongkong Island
Pilumnus dorsipes Stimpson	Hongkong
Pilumnus hirsutus Stimpson	Northern China Sea
Pilumnus lapillimanus Stimpson	China Sea
Polycremnus verrucifer Stimpson	Near Hongkong
Pseudozius sinensis M. Edw.	China
Sphaerozius nitidus Stimpson	Hongkong
Tetralia glaberrima Dana	Hongkong Island

GONOPLACIDAE

**Carcinoplax longimanus* (de Haan)	China. *Foochow
Heteroplax dentata Stimpson	Near Hongkong
Heteroplax transversa Stimpson	Hongkong
Pilumnoplax sulcatifrons Stimpson	Hongkong
Rhynchoplax introversus Kemp	Tai Hu Lake, Kiangsu
Rhynchoplax setirostris Stimpson	Hongkong
Scalopidia leucochirus Richters	China?

PINNOTHERIDAE

Pinnixa penultipedalis Stimpson	Hongkong
Pinnotheres boninensis	China Sea
Pinnotheres obscurus Stimpson	Hongkong
Pinnotheres parvulus Stimpson	China Sea

Xenophthalmus pinnotheroides White	...Hongkong
GRAPSIDAE	
*_Chasmagnathus convexus_ de Haan ...	...Hongkong ; Kiao-chou ; Foochow
Cyclograpsus punctatus Milne Edwards	...Hongkong
Eriocheir leptognathus Rathbun ...	...Shanghai ; Whangpoo River
Eriocheir rectus Stimpson	...Near Macao
-_Eriocheir sinensis_ Milne Edwards ...	...-Foochow ; Shasi ; -Shanghai ; Whangpoo River ; Antung ; Tai Hu Lake, Kiangsu ; -Market Changchu ; -Amoy
Goetice depressus (de Haan)	...Hongkong
Grapsus strigosus (Herbst) Latreille ...	...Hongkong
Helice tridens de Haan...	...Hongkong ; Hankow ; Kiao-chau, Tsingtau
*_Helice latimera_ Parisi...	...*Pei-tai Ho, Chihli ; *Formosa
*_Hemigrapsus sanguineus_ (de Haan)...	...Near Hongkong; -Chefoo, *Pei-tai Ho, Chihli
*_Hemigrapsus penicillatus_ (de Haan)	...Near Hongkong; *Amoy
*_Metaplax longipes_ Stimpson	...Hongkong ; *Chin Bey
*_Metopograpsus quadridentatus_ Stimpson	Cum-sing-moon, near Macao; *Amoy; *Chin Bey.
Plagusia depressa (Fabr.) Latr.	...Hongkong
Plagusia tuberculata Lamarck	...Hongkong
Sesarma affinis (de Haan) Heller ...	...Shanghai
*_Sesarma bidens_ (de Haan) Dana ...	...Hongkong ; *Amoy
*_Sesarma bidens_ (de Haan) Dana ...	...Hongkong ; *Amoy
*_Sesarma dehaani_ Milne Edwards ...	...Whampoa ; -Foochow ; Yangtse-Kiang; Shanghai; Whangpoo River
*_Sesarma haematocheir_ (de Haan) ...	...Hongkong ; Amoy ; Tsingtau; *Chin Bey
*_Sesarma intermedium_ (de Haan) Milne Edw.	...Hongkong ; *Foochow ; Hankow ; Shanghai ; Whangpoo River

**Sesarma lanatum* Alcock	*Amoy
**Sesarma neglectum* de Man	*Foochow; Shanghai; Wu-Soon
**Sesarma minutum* de Man	*Kulungsu Id.
Sesarma plicata Latr.	China; Hongkong
Sesarma sinensis Milne Edwards	Hongkong; Ningpo
Utica sinensis Parisi	China
**Varuna litterata* (Fabr.) M. Edw.	Hongkong; Canton River; Shanghai; *Foochow
OCYPODIDAE	
Camptandrium sexdentatum Stimpson	Near Hongkong
-*Cleistostoma dilatatum* de Haan	-Pei-tai Ho, Chihli
Ilyoplax deschampsi (Rathbun)	Shanghai; Whangpoo River
Ilyoplax stapletoni (de Man)	Chung-ming
Ilyoplax tenella Stimpson	Canton River (brackish water); Whampoa
Macrophthalmus dentatus Stimpson	Near Hongkong
**Macrophthalmus dilatatus* de Haan	Swatow; *Chin Bey
**Macrophthalmus erato* de Man	*Chin Bey; *Amoy
**Macrophthalmus japonicus* de Haan	*Fing-hsien; *Pei-tai Ho, Chihli
Macrophthalmus serratus White	Hongkong
Myctiris brevidactylus Stimpson	Hongkong
**Ocypode ceratophthalma* (Pallas)	*Pei-tai Ho, Chihli.
**Ocypode cordimana* Desmarest	Hongkong; Swatow; ·Foochow; -Chin Bey
Ocypode stimpsonii Ortmann	Tsingtau
**Paracleistostoma cristatum* de Man	*Pei-tai Ho, Chihli
Scopimera globosa de Haan	Hongkong
**Uca demani* Ortmann	*Amoy
**Uca dussumieri* (Milne Edwards)	Macao. *Chin Bey
**Uca lactea* (de Haan)	*Cum-sing-moon; Macao; Hongkong. *Chin Bey; -Amoy
**Uca manii* Rathbun	*Chin Bey
**Uca marionis* (Desmarest)	Hongkong; *Chin Bey
Uca splendida (Stimpson)	Hongkong
Uca brevipes Milne Edwards	China

MAJIDAE

Achaeus japonicus de Haan	Hongkong
**Doclea canalifera* Stimpson	Off Tamtoo Island, near Hongkong; *Foochow
Doclea gracilipes Stimpson	Hongkong
Huenia proteus de Haan	China
**Hyas coarctatus* Leach	Amoy; *Shanghai
Hyastenus planasius Adams and White	China Sea
**Hyastenus elongatus* Ortmann	*Kulungsu Id., Amoy
Hyastenus diacantha (de Haan)	Hongkong
Menaethius monoceros (Latreille)	Hongkong
Phalangipus (*Egeria*) *herbstii* (Edw.)	Hongkong
Plalangipus longipes (Linnaeus)	Hongkong
**Pugettia quadridens* (de Haan) Stimpson	Near Hongkong; *Chefoo

PARTHENOPIDAE

Cryptopodia contracta Stimpson	China Sea
Cryptopodia fornicata (Fabricius) Milne Edwards	China Sea; Hongkong
Harroria albolineata Adams and White	Hongkong
Parthenope carinatus (M. Edw.)	China Sea
Parthenope harpax Adams and White	China Sea
**Parthenope laxciniata* (de Haan)	Northern China; *Chin Bey
Parthenope tuberculosa (Stimpson)	Near Hongkong
Parthenope validus (de Haan)	Hongkong

HYMENOSOMIDAE

**Elamena sinensis* Alcock	*Chin Bey

STOMATOPODA

Chloridella fasciata (de Haan)	China Sea
**Chloridella oratoria* (de Haan)	Hongkong; *Wen-chow; *Pei-tai Ho, Chihli
Gonodactylus edwardsii Berthold	China
Gonodactylus japonicus de Haan	China

THE LIFE HISTORY OF *SPHAERODEMA RUSTICUS* FABR. (HEMIPTERA, BELOSTOMATIDAE) *

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Introductory Statement.—*Sphaerodema* belongs to the family Belostomatidae of the order Hemiptera, the true bugs. The family is represented in South China, as far as our present knowledge goes, by only two species, a species of *Lethocerus* and the present species. *S. rusticus* has been known for well over a century, being described by Fabricius in 1803. In the literature it has also been called *Diplonychus, Appasus* and *Nervinops*. *Sphaerodema* has a wide distribution, being found in the Ethiopian, Oriental, and Australasian Regions, and Southern and Eastern Palaearctic Regions. *S. rusticus* has been reported from Bombay, Ceylon, Burma, Siam, Sumatra, Java, Philippines, China, and Australia, and no doubt future collecting will extend its distribution considerably. Like its relatives of the genera *Belosotoma* and *Abedus, Sphaerodema* carries its eggs on its back. Because of this habit it is called, in Chinese, *Foo Tsz Ch'ung* (負子蟲). There seems to be no name for the bug in the Cantonese dialect, which goes to show that it is not commonly observed in Kwangtung although it is much more common than its gigantic relative, *Lethocerus*, which is known as *Kwai Fa Shim* (桂花蟬), and is considered a food delicacy.

Habitat.—Found commonly in pools and ponds in Kwangtung, clinging to vegetation or other support in the water. They seem to prefer shallow water up to three feet deep, which is liberally supplied with plant growth and trash. A brush lying among growing plants, in shallow water at the edge of a pond is sure to have a big *Sphaerodema* population.

They are not particular in regard to the cleanliness of the water. When dredged up with algae, grass, and trash they immediately scurry to the bottom of the net. They cling to vegetation so closely that they are easily overlooked.

Hibernation.—Adults have been taken in winter collecting in the vicinity of Canton. They showed no signs of hibernation. Adults kept over winter in a laboratory of about the same temperature as the outside, not only remained active all winter but took food from time to time when the weather warmed up a little. They were kept in a small aquarium, however, in which no dirt or trash was provided for hibernation. Specimens of *Lethocerus* kept under the same condition remained active and occasionally took food, while those given an opportunity to hibernate left the water and remained beneath the dead grass upon damp sand, in a semi-torpid condition. Undoubtedly there is a very high mortality of *Sphaerodema* during late fall and early winter when ponds dry up. Many of these ponds have no places whatever that might afford hibernation.

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* Contribution from the Biological Laboratory.

Mating.—Mating, which takes place in the water, has not been closely observed although these bugs have been kept under observation a long time. They cling together and also hide among the supports so that observation is very difficult.

Preoviposition.—The preoviposition period, in the one isolated case observed, was found to be 38 days. Bugs that matured July 11th were left isolated until August 17th, when they were placed together. Thenext day by nine in the morning the male had 47 eggs upon his back. It is probable that these eggs would have been deposited much sooner had the female had a mate. A number of bugs that matured early in July, in isolated jars, were placed together in a common container about July 10th. By the 30th there were eggs present.

Oviposition.—Actual egg-laying was not observed; all eggs laid in captivity have been laid at night. No doubt oviposition is similar to that in *Belostoma,* where after a struggle of varying intensity the male becomes quiet and submits to the performance of the female. The female mounts upon the back of the male with her legs clasped around him, and shifts her position from time to time as occasion demands. The eggs are fastened on with glue which forms a gelatinous pad upon the back. When an egg mass is removed and inverted the glue appears as a thick layer, with the ends of the eggs visible through it. When viewed from above, the glue is not visible, but upon the removal of one or more eggs it becomes apparent that the lower end of each egg is surrounded by glue, in addition to that upon which the egg is placed. With a number of eggs removed their empty places appear not unlike the cells of a honeycomb. The eggs in a given batch are not always laid during a single deposition period, for sometimes a few eggs have been observed early in the evening and by morning many more would be present. This is also shown by the fact that hatching of a given batch often extends over two days. The empty egg masses are no doubt removed by the females when they are ready to deposit more eggs, for the old masses usually remain until a new batch is deposited. The last batch of the season, in the case of one pair, remained on the back for over two months, but perhaps in nature the bug would crawl among trash and push them off. Several batches are deposited by the same female during the same season. Oviposition evidently extends over a period of at least eight months, for a fifth instar was collected on March 20th, and allowing five weeks for nymphal development, oviposition would have been about the middle of February. It is probable that a longer period would be necessary for development at this time of the year. Adults with eggs have been taken as late as the middle of October, and teneral specimens have been collected late in November. Both the early and late records could probably be extended inasmuch as they were made at times when very little field work was being done.

Fecundity.—Extensive data on fecundity were not obtained, but one female deposited 166 eggs during a period of 34 days. This female became an adult July 11th but was not given an opportunity to mate until the afternoon of August 17th. By the next morning she had burdened her mate with 47 eggs. She gave him 52 more on August 26th, 21 on August 29th, 35 on September 7th, and 11 on September 21st. No eggs have been deposited during the last four months but it is expected that egg-laying will be resumed in the spring, the egg-laying thus taking place during two successive seasons. The writer once kept specimens of *Velia watsoni* Drake for a period of over eighteen months. They deposited eggs over a period of eight months one year and again deposited eggs the second season. This will no doubt obtain for a great many of our water-bugs.

Incubation.—During September eggs hatched after an incubation period of seven and eight days. A given batch of eggs often hatches over a period of two days. This is due, in part, to a difference in time of deposition, and in part, to a difference in time required for incubation.

Hatching.—At hatching time a circular break occurs on the upper end of the egg. This break occurs on three fourths the circumference of the egg, making a little cap or lid. The cap is pushed upward and to the side by the emerging nymph, which makes several conspicuous lurches upward. The head of the unhatched bug is well forward, thus making the prothorax the part next the egg cap. The legs are stretched out along the ventral side of the bug, the posterior ones being longer than the body, bending in near the tip of the abdomen, crossing and extending anteriorly on the opposite side of the body. The entire hatching process takes place rapidly.

Behavior of Newly Hatched.—Upon hatching, the nymphs are of course very pale. They swim rapidly about until they find a support, and there rest in their characteristic position with the tip of the abdomen in contact with the surface film of the water. They are gregarious, and if no supports are available they are inclined to use each other for that purpose. Their appetites soon develop and the first meal is likely to consist of their own kind—the last ones to hatch from a given batch of eggs.

Number of Instars.—There are five nymphal instars, and in the tables below is given the duration of each stadium.

Molting.—Nymphs usually lose interest in food the day before molting, although occasionally they will feed within a few hours of molting time. Because of their habit of spending most of the time resting upon some support in the water, molting time can not be predicted by decreased activity or sluggishness, as in the case of Gerrids, Velias, and some other water-bugs. In molting, the skin splits medianly for the entire length of the thorax. This split extends to the head where, near the posterior margin, it forks into a broad y-shape, each fork or branch extending laterally and anteriorly to the anterior margin of the eye. The bug comes forth through this split, the aperture being made much larger by considerable stretching where the body segments fuse. The newly molted bug is ready for a meal as soon as it colors up. The molted skin remains entire except for the split, and that often can not be seen unless closely scrutinized. Measurements and color-markings can be studied as well in the cast skin as in the nymph itself. Mortality at molting time seems to be less heavy than with many water-bugs, such as *Gerris, Ranatra,* etc. Only seven deaths occurred in our rearings, two probably due to inability to molt, a third death may or may not have been due to this cause.

Maturity.—Complete data have not been obtained concerning sexual maturity. Fertile eggs were laid in less than a month's time by some individuals, but they probably reached maturity in less time than this.

Longevity.—Records are being kept now which will throw light on the span of life of these bugs. One bug which matured last May 21st, is still alive (January 1926), and may give us a record of longlivedness. A number of bugs which matured late in June and early in July are alive at this time. The writer had kept specimens of the American *Belostoma fluminea* in captivity for fourteen months when he was obliged to discontinue the observation.

Number of Generations.—The data at hand indicate that at least three generations a year would be possible. There are reasons to believe, however, that there may be more than three generations. In the first place, very few field observations were made in the spring and the record of March 20th may not have been the earliest by any means. Even fewer observations were made in the fall. In the second place, the preoviposition period was counted to be the same as that found in the laboratory, although as pointed out above, the bugs were not mated for some time after becoming adults. In the third place, the temperature in the laboratory was lower than out in the ponds, and that would slow up development. There are still other factors to be taken into consideration, namely, food and habitat selection, and enemies. In their natural environment the nymphs could move about to find their optimum temperature, while in the laboratory they had no choice. In nature they would have a wider food selection, and more varieties to choose from than under laboratory conditions. On the other hand, they had all the food they could consume in the laboratory while those in the wild state had competition, from their fellows, as well as from a multitude of other aquatic carnivors. In the ponds *Sphaerodema* has enemies, while the same is not true in the laboratory.

In the field there is a greater difference in day and night temperatures than is the case in the laboratory. It would be interesting to run a set of experiments to determine the difference in effect on the rate of development, of insects kept at a constant temperature, and insects kept in a fluctuating temperature the mean of which would be the same as that of the constant temperature.

Food Habits.—It is next to impossible to make any observations on the feeding of this species in its natural habitat. In the laboratory the nymphs fed on a large variety of foods including maggots of aquatic and terrestrial flies, adult flies, leaf hopper nymphs and adults, mosquito larvae and pupae, water-boatmen nymphs and adults, back-swimmer nymphs, tadpoles, small fish, snails, and raw beef. The nymphs showed food preference when several kinds of food were offered at the same time, especially was this true if they were not too hungry. When very hungry they grabbed the first available food morsel. When very hungry they also showed more bravery and resourcefulness in attacking live food. At such times they would attack tadpoles several times their own size, and although the tadpoles would race around the dish and even turn over on top of the small nymphs, the latter would hold fast. If not very hungry the nymphs would lose their holds when the victim struggled. Ordinarily, they lie in wait for their food, grabbing it when it comes along, but if very hungry they persue their intended victims. Mosquito larvae, back-swimmers of the genus *Buenoa*, maggots, and tadpoles, in the order named, are the preferred foods. They cared least of all for raw meat and ate it only when very hungry. They preferred mosquito larvae to the pupae, probably due largely to the fact that the larvae were easier to manage. They showed a preference for *Buenoa* over tadpoles, but that may have been due, in part, to the fact that the *Buenoa* were always killed or injured before being given, and also because their size and shape made them easier to manipulate. Everything else being equal, *Sphaerodema* nymphs prefer food that comes into the water to that which remains on the surface. When hungry, the nymphs respond with outstretched fore-legs to any impact on the water, whether made by mechanical means or by a prospective food item.

Behavior.—In the turbid ponds, among vegetation and trash, these bugs are so well concealed that observations on their behavior are quite impossible. In the laboratory, if kept in petri dishes with no vegetation, they may be observed satisfactorily, but aside from food reactions little can be learned. If kept in larger aquaria and supplied with vegetation (a condition more like they would have in nature) they remain out of sight so that observation is difficult.

Enemies.—Sphaerodema is probably quite free from enemies. It is attacked, as many water insects are, by the larvae of *Hydrachnid* mites, and is probably eaten to some extent by certain carnivorous fish. It is eaten also by frogs, and no doubt the nymphs are subject to the attack of giant water-bugs, water-scorpions and predacious beetle larvae.

Description of Stages

Egg.—Somewhat variable in size. Perhaps an average size is 1.543 mm. long by .908 to .976 mm. wide (in greatest diameter). There is considerable increase in the size of eggs as incubation goes on. The shape is oblong oval with very obtuse ends. The top or micropylar end is more pointed than the opposite end. If the long axis of the egg be viewed in one plane the edges appear straight, the greatest diameter to be near the bottom of the egg, and the part of the egg in direct line with the eyes to be either convex or straight, as the case may be. If what might be termed a side view is taken, one edge of the eggs will appear about straight and the other very much rounded, and the greater diameter of the egg will be near its middle. The color is yellowish brown. The surface of the egg appears smooth when viewed with the unaided eye or hand lens. With a binocular microscope, however, a pattern may be discerned. This pattern is revealed by the compound microscope to consist of a network of very small and imperfectly formed hexagons.

First Instar.—A nymph about one day old measured dorsally along medius as follows: length of body 4.086 mm.; length of head .681 mm.; length of pronotum .431 mm.; length of mesonotum .408 mm.; length of metanotum .272 mm.; length of posterior tibia along inner margin 1.203 mm.; width of head across base of eyes 1.362 mm.; width between anterior margins of eyes .635 mm.; width posterior margin of pronotum 1.679 mm.; width hind angles of mesonotum 2.088 mm.; width posterior margin of metanotum 2.201 mm.; greatest width of abdomen 2.247 mm.

General Appearance.—Brown, mottled with many irregular blotches, some pale, others dark brown.

Head.—Median pale line branches near posterior margin, the branches extending laterad and forward, and terminating at the anterior margins of the eyes. Three longitudinal, irregular, pale areas may be seen, one medial, the others midway between this spot and the inner margins of the eyes. Tylus slightly elevated, darker, marked off by two impressed lines which flare out anteriorly.

Thorax.—Pale median line for entire length; margins somewhat explanate; segments not fused. Irregular pale and dark brown areas give mottled effect as on head. Lateral margins of pronotum subparallel, those of meso- and metanotum rounded. Pronotum longest, posterior margin tumid and straight except near lateral margins where it bends forward. Mesonotum intermediate in length, posterior margins sinuated. Metanotum shortest; posterior margin curved forward along middle one third. The lateral margins of each thoracic segment have a brown spot near the middle. These brown spots are bordered on either side by pale areas.

Abdomen.—Brown with small indistinct, pale specks. Anterior and lateral margins speckled, the latter with seven brown spots. The brown spots in turn have pale spots in them. Short, pale median line at anterior margin—a prolongation of thoracic one.

Legs.—Anterior ones banded, intermediate and posterior ones indistinctly speckled. All legs liberally supplied with hairs and spines; tarsi with two claws.

Beneath.—Head, thorax, and legs of motley appearance; abdomen more uniformly brown, with spots on lateral margins the same as seen from above, but less distinct. Flat, blade-like, backward projections of metasternum (which appear like coxal plates) fringed with long, slender, closely-set hairs. These projections, as well as rostrum a shade darker than rest of ventral surface. Abdomen extremely hairy.

Second Instar.—A nymph three days old measured dorsally along medius as follows: length of body 5.652 mm.; length of head .771 mm.; length of pronotum .590 mm.; length of mesonotum .635 mm.; length of metanotum .385 mm.; length of posterior tibia 1.702 mm.; width head across base of eyes 1.747 mm.; width between anterior margins of eyes .681 mm.; width posterior margin of pronotum 2.315 mm.; width hind angles of mesonotum 3.041 mm.; width posterior margin of metanotum 2.996 mm.; greatest abdominal width 2.996 mm.

General appearance much the same as in the first instar except paler; mottled effect less pronounced, entirely absent on legs. Tylus more definitely set off. Abdominal spiracles apparent; lateral abdominal margins fringed with long fine hairs; caudal tip darker, perhaps slightly chitinized; few hairs on upper surface of abdomen.

Ventral aspect similar to that of first instar, but paler; motley appearance no longer present; spiracles very distinct; venter more hairy, especially along median line.

Third Instar.—Nymph three days old measured dorsally along medius as follows: length of body 7.309 mm.; length of head 1.021 mm.; length of pronotum .885 mm.; length of mesonotum .930 mm.; length of metanotum .476 mm.; length of posterior tibia 2.088 mm.; width head across base of eyes 2.111 mm.; width between anterior margins of eyes .839 mm.; width posterior margin of pronotum 2.860 mm.; width posterior margin of mesonotum 3.722 mm.; width hind angles of metanotum 3.904 mm.; greatest abdominal width 4.244 mm.

Appearance has changed very little from that of the preceding instar. Lateral margins of prothorax, and anterior one-half of lateral margins of mesothorax darker, more pronounced in prothorax, all markings less distinct. Caudal tip darker; possesses spines and hairs, tracheae in addition to spiracles can be seen. Anterior tarsal claws reduced.

Fourth Instar.—Measured dorsally along medius as follows: length of body 9.942 mm.; length of head 1.135 mm.; length of pronotum 1.089 mm.; length of mesonotum 1.520 mm.; length of metanotum .590 mm.; length of posterior tibia 2.837 mm.; width head across base of eyes 2.905 mm.; width between anterior margins of eyes 1.089 mm.; width posterior margin of pronotum 4.313 mm.; width across hind angles of mesonotum 5.538 mm.; width posterior margin of metanotum 5.493 mm.; greatest abdominal width 5.765 mm.

Color paler and more uniform. Mottled appearance gone. Lines marking off tylus have punctures at their posterior ends. Anterior margin of pronotum less sinuate; roundish spot on either side of pronotum, midway between front and rear margins, and 1.271 mm. apart; diameter of spots, .158 mm. Hind angles of mesonotum thickened, and might well be called wing rudiments. Spiracles from above appear as indistinct, darker spots. Anterior tarsal claws proportionately small. Ventrally, nymph is pale yellowish brown; spiracles appear as black rings; tracheae visible for a short distance.

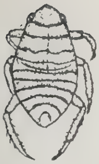
Fifth Instar.—Measured dorsally along medius as follows: length of body 12.371 mm.; length of head .976 mm. (head very much rounded); length of pronotum 1.362 mm ; length of mesonotum 2.883 mm.; length of metanotum .658 mm.; length of posterior tibia 3.972 mm.; width head across base of eyes 3.745 mm.; width between anterior margins of eyes 1.452 mm.; width posterior margin of pronotum 5.629 mm.; width across hind angles of mesonotum 7.945 mm.; width posterior margin of metanotum 7.808 mm.; greatest abdominal width 7.718 mm.

Nymph is very pale. Roundish spots still present on pronotum. Hind angles of mesonotum extend as far back as the posterior margin of metanotum. Very fine line along middle of thorax still persists. Anterior tarsal claws very short. Head and thorax finely punctured. Five indistinct, irregular, pale spots on right and left halves of abdomen, about midway between middle line of body and lateral margins. Lateral margins of abdomen clothed with short, thick, closely-set hairs, in addition to the longer ones already noted.

Rearing Methods

Rearing was a relatively simple matter as these bugs lend themselves to life in captivity. Most of the nymphs were kept in petri dishes, some were kept in larger dishes to ascertain if size of container materially affected size of bug. A bit of vegetation was kept in the containers to provide supports on which the nymphs could rest. Only one bug was kept in each container, however it would be possible to rear several nymphs together. When well fed they are not so very cannibalistic, and if nymphs of the same age are kept together cannibalism at molting time is reduced, for all would be molting about the same time. A few nymhps were reared in containers only one and three fourths inches in diameter, yet they were the normal size.

The nymphs were given all the food they cared for once each day. On a few occasions they were fed two times in one day but the



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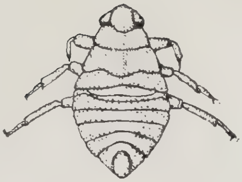

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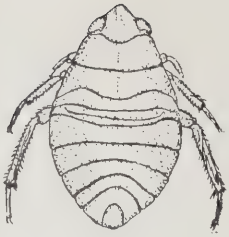

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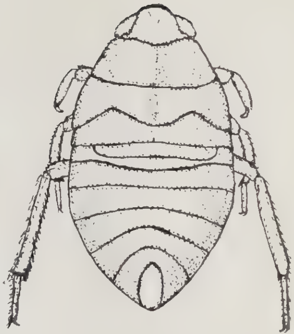

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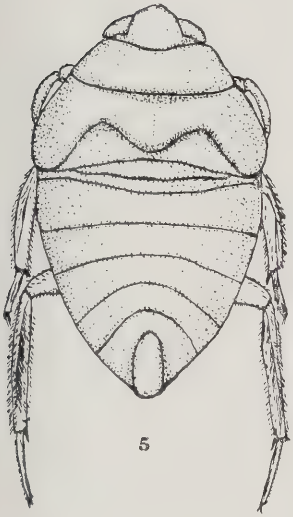

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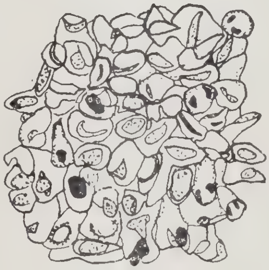

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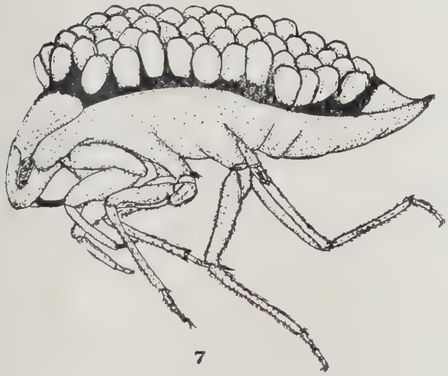

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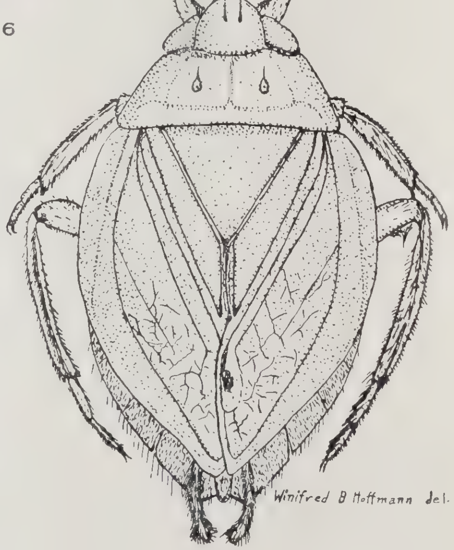

Winifred B Hoffmann del.

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following day they fed reluctantly, if at all, so the practice was discontinued. Foods used and the food preference shown has been given under *Food Habits.* Each day the dead food from the previous day's feeding was removed; the water in the containers was changed from time to time when it became stagnant. Some nymphs, not in the regular set of rearings, were fed irregularly, often skipping a day or two, but no difference was noted in the size or growth rate. One adult was accidentally left in a very small container from June 19th to July 13th without food, but aside from a ravenous appetite seemed none the worse for the experience.

Summary

The results of the rearings are shown in Tables I. and II. These data have been placed in two tables because they represent two different sets of rearings, carried on three months apart. The nymphs enumerated in Table No. I were the progeny of the same pair of bugs, while those of the second table are from several batches of eggs. Many nymphs were killed in the second set of rearings as it was desired to have preserved specimens of each instar, from one day old up to the maximum number of days for a given instar.

From Table No. I it may be observed that twenty-four specimens were reared to maturity. Of this number two were known to be males and two to be females, the sex was not determined in the case of the remaining twenty. While it is occasionally possible to determine the sex by the size and shape, often it is not, and specimens must be very carefully examined to determine the sex. There were five stadia. The average duration of the first stadium for twenty-five specimens was 7.2 days (minimum 5, maximum 23 days); the average duration of the second stadium was 5+days (minimum 4, maximum 6 days); the average duration of the third stadium was 5.2 days (minimum 4, maximum 8 days); the nymphs were in the fourth stadium 7.7 days (minimum 4, maximum 13 days); the fifth stadium was of 38.2 days duration (minimum 30, maximum 49 days). In the second, third, fourth and fifth stadia the averages were secured from 24 nymphs.

By reference to the second table we see that 40 nymphs spent an average of 4.6 (minimum 4, maximum 5) days in the first stadium; 36 nymphs spent 6+ (minimum 3, maximum 11) days in the second stadium; the average duration of the third stadium was 7+ (minimum 4, maximum 14) days for 23 specimens; the average duration of the fourth stadium for 17 bugs was 7.6 (minimum 6, maximum 12) days; the average duration of the fifth stadium was 11.3 (minimum 8, maximum 21) days for 9 specimens.

In the first set of rearings, with twenty-four specimens reaching maturity, the average length of nymphal life was 38.2, the minimum 30, and the maximum 49 days. In the second set, the average nymphal existence was 39.8, the minimum 32 and the maximum 61 days.

The rate of development is dependent more upon temperature than any other one factor, granting of course, livable conditions as far as food and other factors are concerned. This has been discussed more at length under *Number of Generations.* Fish and frogs have not been examined to determine the extent to which these bugs enter into their diet. Undoubtedly this species is more detrimental than helpful from the fish culturist's viewpoint. The value of the species as fish food would more than be offset by the fish food it would consume itself. As a predator on fish it does some damage also, but it is far out-distanced in this respect by its relative, the Giant Water-Bug which will be reported on in a later paper. *Sphaerodema* could be used practically, on a limited scale, in mosquito-control work.

Explanation of Plate

Drawings of *Sphaerodema rusticus* Fabr. Magnification four times natural size.

1 to 5. First to fifth instars respectively.

6. Eggs from back of No. 8; all but four have hatched. Note eye-spots in the unhatched eggs.

7. Lateral view of male showing eggs on back. Note liberal use of glue.

8. Dorsal view of male, with retractile appendages extended.

* * *

TABLE I.

Table of Rearings of *Sphaerodema rusticus* Fabr.

Rearing Number	First instar	Second instar	Third instar	Fourth instar	Fifth instar	Total Days	Sex	Date
								1925
5-71	19	6	7	7	10	49		May 21
5-73	23	3 d						
5-252	6	5	5	9	15	40		Jul. 5
5-253	7	4	5	8	13	37		Jul. 2
5-254	6	5	4	5	10	30		June 25
5-255	6	6	5	10	12	39		Jul. 4
5-256	5	6	6	12	13	42		Jul. 7
5-257	7	5	7	4	13	36	m	Jul. 1
5-258	5	6	4	8	13	36	f	Jul. 1
5-259	6	5	4	7	12	34	m	June 29
5-260	7	4	6	8	13	38		Jul. 3
5-261	5	6	5	7	12	35		June 30
5-262	7	4	6	6	12	35		June 30
5-263	7	4	4	6	11	32		June 27
5-264	7	5	5	8	11	36		Jul. 1
5-265	5	6	5	6	15	37	f	Jul. 2
5-266	6	5	6	10	15	42		Jul. 7
5-267	7	5	8	8	14	42		Jul. 7
5-268	7	4	6	6	13	36		Jul. 1
5-269	5	6	5	5	19	40		Jul. 5
5-270	5	5	5	7	13	35		June 30
5-271	6	5	5	13	17	46		Jul. 11
5-272	5	5	4	8	11	33		June 28
5-273	8	4	6	9	19	46		Jul. 11
5-274	5	6	4	8	19	42		Jul. 7
Average	7.2 (25)	5 + (24)	5.2 (24)	7.7 (24)	13.5 (24)	38.2 (24)		
Minimum	5	4	4	4	10	30		
Maximum	23	6	8	13	19	49		

d = died. m = male f = female

TABLE II.

Table of Rearings of *Sphaerodema rusticus* Fabr.

Rearing Number	First instar	Second instar	Third instar	Fourth instar	Fifth instar	Total Days	Sex	Date
								1925
5-554	4	3 k						
5-555	5	4	3 k					
5-556	5	9	8	6	6 k			
5-557	4	5	7	11	4 k			
5-558	4	5	3 k					
5-559	5	k						
5-560	4	5	3 k					
5-561	4	5	6	1 k				
5-562	5	5	6 k					
5-563	5	3	5	3 k				
5-564	4	5	4	6 k				
5-565	4	7	3 d					
5-566	5	9	14	12	21	61		Oct. 25
5-567	5	5	7 k					
5-568	5	4	6	8	5 k			Sept. 22
5-569	5	10	1 k					
5-570	5	16 d						
5-571	4	11	11 d					
5-572	5	7	4 k					
5-573	5	4	8	2 k				
5-574	5	4	4	4 k				
5-575	5	1 d						
5-576	4	4	5	5 k				
5-577	4	10	2 k					
5-578	4	8	5 k					
5-641	4	5	7	7	7 k			
5-642	4	5	5	8	2 k			
5-643	4	6	9	7	9	35		Oct. 3
5-657	5	4	6	7	3 k			
5-658	5	5	7	6	8 k			
5-659	5	6	5 d					
5-660	5	6	2 d					
5-661	5	4	6	8	1 k			
5-662	5	4	8	7	9	33	m	Oct. 1
5-701	5	5	8	7	9	34	m	Oct. 2
5-723	5	6	6	7	8	32	f	Sept. 30
5-724	5	6	5	7	9	32		Sept. 30
5-733	5	7	10	6	11	39		Oct. 7
5-734	5	10	7	6	9			
5-760	4	10	12	10	17	53		Oct. 18
Average	4.6 (40)	6.† (36)	7.† (23)	7.6 (17)	11.3 (9)	39.8 (8)		
Minimum	4	3	4	6	8	32		
Maximum	5	11	14	12	21	61		

k = killed for specimen
d = died
m = male
f = female

A Correction

The name William M. Porterfield, Vol. III, No. 1, page 35 should be corrected to read Williard M. Porterfield.

Notice

It was necessary to omit the Abstracts and Reviews in the present issue but it is planned to continue the service in future issues.

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